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A
TREATISE
ON
AUSCULTATION.



Fig. 2.

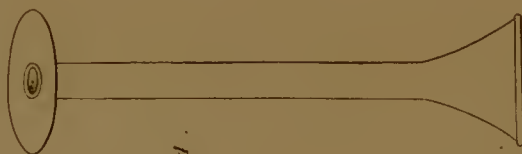


Fig. 4.

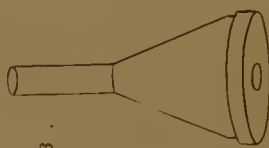


Fig. 3.



Fig. 1.

A

TREATISE ON AUSCULTATION,

ILLUSTRATED BY

CASES AND DISSECTIONS.

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TO
THE MEMBERS OF THE
HARVEIAN MEDICAL SOCIETY OF EDINBURGH,

THE FOLLOWING ESSAY
IS RESPECTFULLY DEDICATED

BY
THE AUTHOR.

ADVERTISEMENT.

IN the year 1829, the Harveian Medical Society of Edinburgh, intimated, as the subject of their Prize Essay, “ The Diagnostic Properties of the Stethoscope, illustrated by dissections.” The Author of the following pages had the honour of being the successful competitor; and this mark of the approbation of the distinguished Members of that Society, has been the chief inducement for submitting this, the Harveian Essay, to the profession.

The present Work presents little that is new to the experienced Stethoscopist; yet the Author hopes that, having endeavoured to include in it all that has been made known on this subject, from the time of its great inventor to the present, and given a few Practical Illustrations, he will have rendered

this portion of his Essay some acquisition to the Student in Auscultation.

The Pathological Department, it is trusted, will be of some value from the Cases and Drawings which have been furnished.

ROYAL INFIRMARY,
October 1830.

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ERRATA.

The reader is requested to alter the following with his pen,—

- Page 69 line 10, *for* and *read* to
 — 70 — 25, *before* than *read* after the operation
 — 75 — 17, *for* cap *read* cup
 — 91 — 22, *after* progress *read* of the blood in the former
 — 100 — 19, *for* contractility *read* elasticity
 — 191 — 23, *for* occupied *read* was found to occupy

ARRANGEMENT OF THE PLATES.

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TREATISE

ON

AUSCULTATION.

INTRODUCTION.

AUSCULTATION is founded on the fact of certain organs in the body producing peculiar sounds during their action, which are audible on the application of the ear externally; these in health continuing nearly the same, but in disease varying according to the nature of the affection. The use of auscultation in the diagnosis of diseases forms an important epoch in the history of medicine: since its invention, the physician prescribes with confidence, where formerly this, in many cases, was done with great hesitation, owing to the frequent difficulty of forming a correct diagnosis. By the practical physician, then, auscultation ought to be regarded as one of the most valuable accessions ever made to the practice of

medicine, for no one surely will deny, that in proportion as the pathology of any disease is made known to us, so will be our success in the direction of means for its cure. It is in vain to say, that it is useless or unnecessary to know minutely the pathology of diseases usually termed incurable,—some of those made known by auscultation being of this nature; for we would ask, Are these for ever to remain incurable, notwithstanding the daily advances of the medical art? besides, Does not the alleviation of such, many of which could not be ascertained correctly, without the aid of auscultation, form a great part of the practice of the physician?

In thus advocating the use of auscultation, however, we do not mean to say that it is in all cases infallible, or that it is to be entirely confided in, to the exclusion of other means, such being contrary to the experience of all, and of none more than its illustrious inventor; but that auscultation has been found, by all who have seriously tried it, to be of the utmost benefit in a very large class of diseases, we unhesitatingly affirm, being forced to this conclusion, both from our own, and the more extensive experience of others; and when we see for its advocates abroad, LAENNEC, ANDRAL, BERTIN, &c. and know that it is supported in this country by many eminent physicians, who have proclaimed their confidence in auscultation by an extensive use of it,

both in public and private practice—which our medical literature sufficiently testifies—we cannot for a moment entertain a doubt of its value; and so convinced are we of this, that we will venture to say, there is not one, even the most sceptical, who, after a fair trial, but will become the admirer and the advocate of auscultation. But this is not to be done in a day, any more than a general knowledge of the pulse is to be obtained by the examination of a single patient; this we know is with difficulty attained by the student, and only after some experience; and, indeed, there are few symptoms which it is not necessary for him to witness frequently, before becoming familiarized with them;—so it is with most of the signs afforded by auscultation.

To LAENNEC belongs, not only the distinguished honour of having invented this mode of observation, but of having brought it at once, almost, to perfection, so that there is now little left to be desired in this department.

Auscultation may be immediate or mediate; in the former, the ear of the auscultator is applied close to the surface of the body; in the latter the sounds are conveyed by an interposed substance between the ear of the observer and body of the patient. This interposed substance LAENNEC has termed a *Stethoscope**. By its means all

* From *στήθος* the chest, and *σκοπεῖν* to explore.

his observations, and those mentioned in this paper, were made; and, indeed, mediate auscultation offers so many evident advantages beyond immediate, that we shall not argue the point here, but refer those who doubt to the splendid work of LAENNEC, where the subject is ably discussed.

It is in diseases of the chest, more especially of the lungs, where auscultation has been found most useful; and when the importance and frequent obscurity of these are taken into account, the means of forming a correct diagnosis could not have been bestowed with more utility, than in those mentioned. The importance of auscultation, then, may be inferred from the known frequency of thoracic diseases; and, from calculation, it appears that these form at present* about one-fifth of the medical cases admitted into the Royal Infirmary of Edinburgh, and this, as far as we have examined, seems to be the general proportion observed throughout this country. With regard to the mortality of these diseases, Dr BLACKMORE† says, that from an extensive statistical account of medical cases, which occurred both in public and private practice, throughout the British dominions, “the disorders of the thoracic organs are seen to take the lead in relative mortality, and that the chronic affec-

* 1829.

† Edin. Med. and Surg. Journal, No. ci.

tions of the lungs, exclusive of proper consumption, are nearly twofold higher in mortality than the acute diseases."

Having such facts before us, and the testimony of so many able physicians, of the utility, we might almost say the absolute necessity, of auscultation in such diseases, we ought to be slow in rejecting the use of the stethoscope, nor ought we to utter one harsh word against it; for never had the physician more reason to be proud of his mastery over the secrets of nature, than of the power which auscultation has given him, of unfolding many of the most occult points in the practice of his profession; and, indeed, if it afforded nothing more than an additional means of confirming our opinions formed from the assemblage of symptoms, usually taken into account by physicians before the invention of auscultation, it ought to be hailed with great satisfaction by all.

CHAPTER I.

ON THE STETHOSCOPE.

THE instrument by which mediate auscultation is performed has been termed a Stethoscope; it consists essentially of a substance which can convey the sounds produced within the body to the ear of the observer: a cylinder of wood has been most generally used for this purpose, variously modified by different observers.

Many of the sounds, heard both in health and in disease, are best conveyed through such a cylinder, with a central perforation terminating in a conical-shaped extremity, so as to collect and transmit the pulsations of sound. Other impressions, such as those of the action of the heart, are said to be conveyed most perfectly by a solid cylinder, and Dr WILLIAMS, in his Rational Exposition, explains it in the following way: He says, " Sounds, which originate in air, are conveyed most perfectly by the air;" hence the reason why the sounds produced in the lungs are most readily transmitted by the perfo-

rated cylinder. Again, he says, " Sounds originating in fluids or solids, are most perfectly transmitted by substances of similar density;" hence the reason why the heart's action is best transmitted by a solid cylinder. In fact, according to his view, sounds are conveyed most easily by substances of similar density to those in which they originate. Light woods, such as cedar or fir, have been found most advantageous for the construction of the stethoscope.

The best stethoscope in use, or at least one which answers well the purposes required, possesses as near as possible the advantages of both modifications. (See Plate No. I. Fig. 1.) It consists of a cylinder of cedar of about 12 inches long, and $1\frac{1}{2}$ in diameter, perforated with a bore of about $\frac{3}{8}$ ths of an inch in diameter, terminating in a conical-shaped extremity (Fig. 2.), which, when the instrument is required for the auscultation of the heart, can be obliterated by a stopper of the same wood, fitting accurately, and thus converting the one modification into the other (Fig. 3.) The instrument is further hollowed out slightly at both extremities, for the better adaptation of these to the surface of the body and the ear of the observer. Most generally, too, it separates in the centre, by a similar contrivance to that of the stopper, and this for two reasons; it makes the instrument more portable; besides, it enables the observer

to use it of half the usual length for either purpose, the stopper fitting into the conical cavity of each piece; and this is often of great use when the sounds are very faint, or when we wish to make a more minute examination.

Such a stethoscope is very similar to that used by LAENNEC, and indeed is the same, with the exception of the shape of the cavity at the extremity, which in LAENNEC'S was parabolical. This kind of cavity Dr WILLIAMS is of opinion does not convey the sounds nearly so well as the conical termination, the reverberations of sound, being in the former frequently reflected from the walls of the cavity before entering the tube, become much weakened; but this he believes is obviated in the conical cavity, by the direct vibrations being concentrated with little reflection, consequently the sounds are very slightly impaired.

We are not sure, however, that this view of the subject is the correct one; for it is stated in the latest observations on acoustics, that, with regard to reflection, sound does not obey the same precise laws as light: there is a want of that exactness and nicety which is characteristic of the latter. An instrument on the principle of that noticed by Dr WILLIAMS, however, is probably the best for the purpose; indeed, we may mention here, that we had this principle extended throughout the whole

length of the instrument, and found such a stethoscope to answer the purpose quite as well, if not better, than that of Dr WILLIAMS; and the following remarks of Professor LESLIE, on the physical properties of the ear-trumpet, perhaps explain the advantages of a stethoscope on the principle mentioned:—"The wide mouth of that instrument, it is well known, is turned to catch the stream of sound; the extent of pulsation is gradually contracted as the tide advances; and the same quantity of impulse being probably maintained, the vibrating energy is intensely accumulated at the narrow extremity, where it strikes the cavity of the ear. A trumpet of this form might, in many cases, be found very advantageous, not only for remedying the defects of the organ of hearing, but for assisting the observer to collect feeble and distant sounds*."

A horn or ivory cap attached to the auricular extremity of the stethoscope, is now much in use. It has, however, been objected to by several authors on different grounds. It is a matter of small import, and probably the advantages attending its use counterbalance its defects, if any, entirely; for it is certain that such a contrivance has been found to enable many to adapt the instrument better to the ear, which is of considerable im-

* Edinburgh Encyclopædia Britannica, 1830, Acoustics.

portance to the student in auscultation ; but, indeed, after some experience, he will become familiarized with almost any instrument.

Having given a description of the construction of the most approved stethoscope, we shall next notice its manner of application. LAENNEC recommends that the instrument be held like a pen, with the fingers touching at the same time the extremity of the stethoscope in contact with the body, and the surface of the body itself, to ensure its perfect application ; and such instructions are highly necessary to the learner, for nothing is more common, than to see him allow the edge of the instrument to be raised from the surface of the body, especially during the respiration of the patient ; many extraneous sounds are admitted and caused by this, in particular that produced by the separation of the slight adhesions formed between the skin and extremity of the stethoscope. This sound is sometimes very loud ; and, in one case of disease of the heart, in which the impulse was strong, we observed it very nearly to resemble some of the sounds which are occasionally found to accompany the contraction of the ventricles. The instrument was applied below the ensiform cartilage, and this peculiar sound was produced entirely by the separation alluded to, caused by the strong impulse of the heart, and indeed synchronous with it ; removed, however, by a slight

additional degree of pressure. Such a coincidence might easily mislead those unaccustomed to auscultation.

The other extremity of the instrument is to be adapted to the ear of the observer, the perforation being placed opposite to the meatus auditorius externus. Thus situated, a slight degree of pressure is to be exerted, so as to adapt closely both extremities of the stethoscope. The degree of pressure required is very slight, and very seldom gives any pain, as has been alleged by some, unless when the surface happen to be very tender, in which case something soft ought certainly to be interposed; and this, when not too thick, a layer of lint for example, is found to affect the intensity of the sounds little, if at all. An interposed substance is also sometimes necessary, especially in emaciated subjects, for the sake of obtaining a flat surface of sufficient extent, for the proper application of the instrument.

During auscultation, silence, of course, is indispensable, and great care is necessary, lest the friction of the clothes of the patient upon the instrument, or upon the chest in its neighbourhood, take place. The patient may be seated or lying in bed; but, in the latter case, in examining the dorsal region, it is better to make him sit up with his hands crossed before him, and his head a little bent forwards. Although many of the indications are easily heard through pretty thick clothing, still it is bet-

ter to have this as thin as possible : the patient should merely be in his shirt ; a more satisfactory examination being always obtained in this way : besides a very fertile source of extraneous sounds is thus avoided. Woollen clothing is inconvenient, from the noise which it causes.

With regard to the observer, LAENNEC says, that he must avoid, as much as possible, uneasy or inconvenient postures, while making his observations, as tending to produce extraneous sounds, which would impede his progress in auscultation.

Such then, are a few remarks on the most approved stethoscope, and its manner of application, on which much more might be said ; but a little experience on this subject is worth volumes of directions. The young observer will, with a little attention, soon find out the most convenient and useful methods of application, and be enabled to separate the sounds produced within the chest, from external ones ; for we repeat, that the many apparent difficulties will soon vanish before a little steady experience ; but the stethoscope must not be taken up, and after a few unsuccessful trials laid down for ever in despair.

The stethoscope has been variously modified by different observers ; however it is our intention to notice only that of M. Piorry.

The stethoscope of M. Piorry is essentially the same

as that we have described, when without the stopper, and with the ivory cap, the only difference being, that in the former the walls of the tube are thinned away, so as to give the instrument a trumpet appearance; it is also shorter and of one piece (see Plate I, Fig 4.). For the purpose of hearing pulmonic sounds, this instrument is probably just as useful as the other; but it seems not, even by the aid of the wooden stopper, which is used to obliterate the conical cavity when required, to convey impressions of the action of the heart so distinctly; and this we believe to be owing to the much smaller number of woody fibres in the one than the other, or, in other words, to the thinness of the walls of the tube. It has the advantage of easier portability, but we certainly prefer one of the form first described, though not so portable, as possessing an additional advantage to that of M. Piorry's, viz. that of transmitting the sounds caused by the action of the heart better*.

In the 92d Number of the London Medical Gazette

* In the Journal Hebdomadaire de Medecine for June 1830, M. Piorry has given an account of a copper stethoscope of great portability; which has combined with it an instrument for mediate percussion. We have not seen this new instrument; but, according to its inventor, it seems to answer well the purpose intended. The construction of the stethoscope, however, after all, is a matter of minor importance.

for September 1829, there is a drawing of a jointed stethoscope, with a letter from the inventor, giving an account of it: however, as its disadvantages appear to us to be obvious, we shall not notice it further, but refer those who wish for more information on the subject to the periodical mentioned.

CHAPTER II.

ON THE PHYSICAL SIGNS OBSERVED IN THE LUNGS
AND PLEURÆ BY AUSCULTATION.

WE now commence by far the most important part of our subject, the consideration of the various physical signs observed in the lungs and pleuræ, in health and in disease, which are made known to us by means of auscultation.

SECTION I.

AUSCULTATION OF THE RESPIRATION.

THE sounds heard during the action of respiration, vary according to the part examined, and the peculiar condition of the lungs in health and in disease. The following are the different kinds of respiration heard ; namely, the Vesicular, Puerile Vesicular, Bronchial, Tracheal, Cavernous, and we may add, Amphorique Respiration. We shall consider each separately.

I. Vesicular Respiration.

This is named from its cause, and the following is LAENNEC's excellent account of it: "We hear," says he, during inspiration and expiration, a slight but extremely distinct murmur, answering to the entrance of the air into, and its expulsion from, the air-cells of the lungs. This murmur may be compared to that produced by a pair of bellows *, whose valve makes no noise; or still better to that emitted by a person in a deep and placid sleep, who makes now and then a profound inspiration. A very deep inspiration, made slowly, will sometimes be scarcely audible; while an imperfect inspiration, such, for instance, as hardly at all elevates the chest, provided it be made quickly, may produce a very loud sound." When the sound of respiration is found to be weak, it is recommended that the patient be made to read or recite aloud, as long as he can without inspiring, or cough. Subsequent to these efforts, the most audible respiration is generally found, the individual being obliged to inspire deeply, and suddenly.

The cause of this phenomenon is the passage of the air into and out of the air-cells of the lungs; hence, where-

* Gently blown.

ever these are nearest the surface, or farthest removed from other and louder thoracic sounds, vesicular respiration will be the most audible. It may be heard generally over the chest, except in the regions where bronchial and tracheal respiration occur; and sometimes in the precordial region. This sound indicates a healthy condition of the lungs, and is found to be present in adults. Wherever such an indication, then, is weakened, or absent, except in the places mentioned, it is, in general, just to conclude that there is some morbid action going on in the lungs, at the corresponding part, or an intervention of something morbid between the lungs and parietes of the chest. The absence of vesicular respiration is most usually found to take place in all cases in which there are obstructions to the free entrance of the air into the cells of the lungs;—as in phthisis, from a deposition of tubercular matter to a considerable extent, and its consequences—in pneumonia, from the effusion in the second and third stages—in emphysema and catarrh, from the presence of mucus, or from tumefaction of the mucous membrane of the bronchi—in pleurisy, from effusion into the chest—and in pneumothorax, from the presence of air. In effusion into the chest, however, either liquid or gaseous, in consequence of occasional adhesions between the pleura pulmonalis and costalis, the sound of respiration may be partially present. Percussion and

the other symptoms, of course, must always be taken into account; in the diagnosis of each particular affection. During our observations, it is necessary to compare corresponding parts of the chest; for the sound of respiration varies much in intensity in different individuals, while in a state of perfect health.

Occasionally, in catarrhal affections, the sound of vesicular respiration becomes suddenly feeble, or entirely absent, in particular places, as suddenly returning, generally accompanied with catarrhal rales.

The presence of the sound of vesicular respiration does not always denote a healthy state of the lungs, for, as noticed by ANDRAL, this sound is often heard when there are numerous miliary tubercles in the lungs; but when the quantity of morbid matter is considerable, there is, in general, a diminution of the vesicular respiration, and this most usually happens on one side more than on the other, tubercular deposition being, for the most part, more profuse in one lung, and towards its upper part.

II. *Puerile Vesicular Respiration.*

Although this species of respiration belongs properly to childhood, hence its name; still it is found occasionally to continue for some time beyond the period of puberty, and in a few cases during the whole period of life.

Sometimes the respiration is found to assume this character after unusual exertion. Again, in morbid conditions of the lungs, when one, or a portion has become impermeable to the air, or in cases of effusion into the chest, or presence there of any accidental production, such as an aneurismal or other tumor, puerile respiration is often developed in the healthy or uncompressed portions; thus frequently affording evidence of the existence of disease. From frequent observation on this subject, Dr FORBES says, "that puerile respiration is of great value, and may be safely considered as pointing out the obstruction of a considerable portion of lung." Whenever, in our observations, then, we meet with this sign in an adult, we ought to pursue our examination with an additional degree of minuteness and care. Puerile respiration sometimes occurs in fevers, and in nervous complaints; but the most usual remote cause is the impermeability to the air of a portion of the lungs.

Puerile respiration has the same character as the vesicular first described, with this difference, that it is much louder, more distinct, and can be heard through much thicker clothing, through the bed-clothes, for example. It is heard in children in exactly the same situation as the vesicular respiration of adults, and indicates a healthy state of their lungs. Its situation of course varies in adults, when developed in consequence of disease.

With regard to the cause of this sound, it is, as suggested by LAENNEC, probably in consequence of the dilatation of all the air-cells to their full extent; and this agrees with the opinion of Dr WILLIAMS, who believes it to be owing to an extreme activity in the function,—the respiration being performed with greater perfection and energy. He also remarks, that, in young persons above the age of puberty, increased exertion renders the respiration puerile. If such, then, be the true explanation, of which there seems little doubt, it is easy to understand why an increase of sound should take place, when we consider that a larger quantity of air is required to produce the more perfect penetration of the air-cells.

III. *Bronchial and Tracheal Respiration.*

These are modifications of each other, being essentially the same in character, only differing in degree, according to the diameter of the tubes of the lungs through which the air has to pass. By Bronchial Respiration is understood that sound which takes place in the larger bronchi, by the passage of the air through these tubes. It wants the distinct murmur, or feeble crepitation, which characterizes the vesicular respiration. The idea of a drier sound, says LAENNEC, seems to be suggested to us; and we at the same time feel distinctly that the air is passing

through a large empty space. According to Dr WILLIAMS, the sound is hollower, more tubular and blowing, and is caused by the approach to the surface of many bronchial ramifications of considerable size.

The sound produced by Tracheal Respiration is, as already mentioned, the same in kind, but greater in degree, than that of the bronchial; and this is owing to the greater caliber of the tube through which the air has to pass, viz. the trachea.

The sounds of the different kinds of respiration, however, will be far more easily understood by a few careful observations on a healthy chest; and by a reference to the table at the end of this paper, taken from Dr WILLIAMS' work, which appears to be generally correct, the regions where the different kinds of respiration are heard, will be better understood than by any description. Dr WILLIAMS refers for the illustration of tracheal respiration to the anterior and lateral parts of the neck, the superior sternal region (5.), the superior portion of the infra-clavicular regions (2.), and the cervical portions of the acromial regions (11.); of bronchial respiration, to the middle sternal region (6.), and those parts of the mammary regions (3.) contiguous to it, and in thin subjects to the principal part of the interseapular *

* We have generally found it present here, more or less.

(13.) and axillary regions (8.); and of the vesicular respiration, to the remaining parts of the chest (See Plate No. II.)

Such, then, is the general state of the respiration in a healthy person; but on the invasion of disease, this is often much altered. Bronchial respiration is frequently developed, where previously it did not exist. This, says LAENNEC, is always most distinct at the roots of the lungs, and in the upper lobes, and when the air is prevented from penetrating the vesicular structure of the lungs, is the only kind of respiration which can take place. It is found to be louder and more distinct, in proportion as the lung is more condensed, and thereby rendered a better conductor of sound.

Bronchial respiration, then, occurs in various affections of the chest, from condensation of the lungs; caused by pleuritic effusion, induration from hepatization, effusion of blood, deposition of tubercular or melanotic matter, and, in fact, from any thing which renders the vesicular parts of the lungs denser, and thereby a better conductor of the sound of the bronchial respiration, which naturally occurs in such situations, but which is not at all, or only very feebly transmitted by the vesicular structure, in its natural state. Enlargement of the bronchial tubes likewise develops this kind of respiration, by admitting a larger column of air, and at the same time, in general,

rendering the vesicular texture more compact. Bronchial respiration also sometimes occurs in small excavations in the lungs. Great care is necessary in our explorations, to mark well the situations where bronchial and tracheal respiration naturally occur. In disease, the extent over which these are heard, indicates the extent of the affection.

IV. *Cavernous Respiration.*

In certain diseases of the lungs, instead of the vesicular respiration being heard, the sound assumes the character of that of the tracheal or bronchial respiration; in general more like the former than the latter; and, indeed, it is so similar, that a most correct idea of it may be obtained, by the application of the stethoscope over the trachea during respiration. Dr WILLIAMS says, on this subject, "that the sound thus produced is so remarkable, and so like the blowing of air into any little hollow objects, as shells of different sizes, that the mind would at once, and as it were instinctively, refer it to its true cause." The air, in cavernous respiration, seems as if drawn from the end of the stethoscope, or blown into it during respiration.

Cavernous respiration, as its name implies, takes place in, and indicates the existence of, a cavity in the substance of the lung. It occurs in excavations of the lungs,

from softened tubercles, abscess, gangrene, largely dilated bronchi, and, we believe, in the rare case of a cavity between the pleura pulmonalis and pleura costalis, circumscribed by firm adhesions, and communicating with the bronchi.

Pulmonary excavations may exist, without giving rise to any characteristic respiration, because it is necessary that these be tolerably empty of fluid matters, before it can take place;—the physical cause being the rushing of air into, and expulsion from, a pretty large cavity. It varies according to the quantity of fluid in the cavities, and may be occasionally altogether absent for a time, from the blocking up of the bronchial communication. But frequent examination, in such suspected cases, will remove all doubt; and, when present, it may be said to be a very correct indication of the existence of an excavation in the lungs, the nature and cause of which must be learned from other symptoms. In cases where there is doubt as to the existence of a cavity, the auscultation of the cough and voice, in general, will remove all uncertainty.

The puffing, or blowing, respiration of LAENNEC is a species of cavernous respiration, and occurs in cavities, in general nearly empty of fluid, whose parietes are dense and smooth, communicating, at the same time, freely with the bronchi. This sound has been very well com-

pared, by LAENNEC, to that of blowing out a candle. It occurs during very quick and deep inspiration, coughing, and in some cases, where well marked, after every syllable, during speaking. It is evidently caused by the sudden entrance of air into the cavity, through the small opening in its walls, during these efforts; and is, in fact, just the cavernous respiration suddenly performed.

We have given one case where it was very well marked. It indicates the presence of a cavern.

V. *Amphorique Respiration.*

Occasionally the sounds heard during respiration exactly resemble those produced by blowing into a bottle or other hollow vessel: hence the name of this kind of respiration. There are many degrees of amphorique respiration, and these have been considered to indicate different degrees of morbid affection. Amphorique respiration is a modification of the cavernous. It varies much in intensity; and Dr WILLIAMS, in his *Observations on Cavernous Respiration*, says, "That, by the variety of sound, it is possible to judge of the size of the cavities; the rule generally being, that the deeper and hollower the sound of cavernous respiration, the larger the cavity*." This, as a general remark, may be true, but it

* Rational Exposition.

is quite evident, that either a higher, or deeper and hollow sound, may be produced by the same cavity, according to the diameter of the openings into it; and the following simple experiment seems to shew this. A certain sound being produced by the effort of blowing into a bottle, let this be of what diameter it may, a much deeper sound can always be obtained by simply closing the aperture into the bottle, one half or more; and repeating the process of blowing; and the more the aperture is closed, the deeper the sound will be.

The deep and hollow sounds described by Dr WILLIAMS as occurring in caverns during respiration, are imperfect examples of that kind of respiration we are now describing. The most perfect takes place in those cases where there are a number of caverns, with dense smooth walls, very freely communicating with each other, and with the bronchi; or very large cavities; and doubtless consequent upon the entrance, expulsion, and circulation of the air through these caverns.

Amphorique respiration, then, is an additional evidence of the existence of cavities in the lungs, containing a good deal of air; and when the sound is well marked, and over a considerable extent, the excavation may be said to be extensive, and communicating freely with the bronchi; but from what has been said on the tone of the sound, we fear that little reliance is to be placed on this,

as an indication of the size of the excavation; it depending, as we have endeavoured to shew, on the dimensions of the aperture into it, as well as on the dimensions of the cavity itself.

The amphorique respiration occurs also in certain cases of pneumothorax, in which the cavity of the pleura communicates with the bronchi. And when it exists alone, LAENNEC has been led to attribute it either to there being more than one fistulous opening, or to the cavity being very large, and containing only a very small quantity of liquid. The first conclusion is incorrect; it can take place in cases where there is only one opening, but probably less perfectly, than when there are several. Besides, it is not necessary that the cavity contain a very small quantity of fluid, or any at all. The apertures, when fluid is present, of course must be above the level of this before it can take place. The firmness and smoothness of the walls of the cavity render it more or less perfect; and a very simple experiment will shew the importance of this, for the proper development of the sound.

Having first ascertained the sound produced by blowing into the mouth of a phial, let a small portion of any soft or porous substance be introduced, and the sound will be immediately rendered duller and less distinct; but this does not happen when the substance introduced

is dense, and at the same time possesses a smooth surface—a pebble for example. The sound will then only be heightened in its tone, in consequence of the space occupied by the substance introduced; but, at the same time, it will be clear and distinct. A similar effect is produced by tying a thin membrane rather loosely, at least in such a manner that it can be tightened by slight pressure with the finger, on the extremity of a bottle, of which the lower part has been removed. The sound produced by blowing into this is very dull and indistinct, but the moment pressure is exerted by the finger on the membrane, so as to tighten it, the sound becomes at once distinct and clear. This experiment shews the importance of the presence of density, or at least tension, which seems to have a similar effect, in the walls of the cavity, before amphoric respiration can take place. Such a condition of parts, it is easy to imagine, may often happen; and when a spongy, or ragged and breaking down portion of lung forms part of the parietes of a cavity, then are the physical circumstances the same; so that it is difficult to pronounce, from the presence of the amphoric respiration, more or less perfect, the exact state of the parts within; all that we can depend upon seems to be, that when this kind of respiration is present, one large cavity or a series of smaller ones are indicated. When well marked, and heard over a large surface, we may with

certainly pronounce the existence of one or other of the above in the chest, containing air, and with dense parietes, in both cases freely communicating with the bronchi. It is found to be present in cases of phthisis, from tubercular caverns; and in cases of pneumothorax, when there is communication with the bronchi. The other, and general symptoms, must be consulted to discover the particular affection.

SECTION II.

GENERAL REMARKS ON THE RALES.

HAVING considered what may be termed the different kinds of Simple Respiration, we shall, as next in order, give an account of the various sounds which are found to accompany or supersede these, in different morbid affections of the lungs.

The sounds to be described have been variously named by different writers. They are termed *Râles* or *Ronchi*, by LAENNEC, who, however, throughout his writings, makes use of the former term alone; and, indeed, most who have followed him do the same. Dr WILLIAMS prefers making use of the latter term, because he says it both expresses the subject better, and is more accordant with the usual style of medical language. These terms

have been translated into Rattle, by some English writers; and the term Wheeze has also been employed.

It appears to be a matter of very little consequence which of the terms is used; but, being once in use, it ought certainly not to be materially altered afterwards. In the following pages we shall make use of the original term *Râle*: 1st, Because it was used by LAENNEC, is now in general use, and medical men have become more habituated to it than to any other; 2d, It expresses the subject just as well as any of the other terms, and better than either of the English names, these to an English ear certainly expressing something very different from the sounds, the nature of which they have been used to describe.

Perhaps it would be better if all the different rales had merely been considered as characteristics of different species of respiration; for example, instead of saying, sonorous, sibilous, or crepitant rales, we might say, sonorous, sibilous, or crepitant respiration. But we shall, as formerly stated, adhere to the original French term of LAENNEC, "*râle*," this being so generally in use.

Most of the rales occur in consequence of some obstruction to the free entrance of the air into, and exit from, the different parts of the lungs. This obstruction is generally caused by the presence of fluids, of different density and tenacity; sometimes in catarrh, in conse-

quence of thickening of the internal membrane of the bronchi; and, when present in emphysema, which is rare, the rale seems to be owing to an increased sound of vesicular respiration, which, in consequence of the cells having become enlarged or united together, takes place with a considerable crepitating noise, a very feeble degree of which is often to be perceived in the vesicular, especially the puerile vesicular respiration.

LAENNEC divides the rales into five species; but it is perhaps better to make only four, as done by MARTINET; two of those described by LAENNEC being very much the same in character, though occurring in different diseases, and probably from different causes. The different species of rales, then, which we shall describe, are,—I. The Râle Crepitant; II. The Sibilous Rale; III. The Sonorous Rale; and, IV. The Mucous Rale. The three last may be shortly termed Catarrhal Rales. They generally occur together, especially the two first.

I. *The Râle Crepitant.*

We shall treat of this first, because, in considering the respiration, we commenced with that which occurred in the vesicular structure of the lungs, which is believed to be the case with this species of rale. LAENNEC says

that it resembles the crepitation of salts in a vessel exposed to a gentle heat; but the comparison of Dr WILLIAMS, who describes it as resembling the sound produced by rubbing a lock of one's own hair between the finger and thumb, close to the ear, is better. The experiment can be more easily tried, and for the beginner is always at hand, as a standard of comparison: besides, it seems to give a better idea of the sound produced, simply by its being weaker than the sharp kind of crepitation of salts, and nearer the intensity of the actual râle crepitant.

There appear to be various opinions concerning the cause of this râle. Dr WILLIAMS has offered the following explanation: he says, "The distended vessels, and the serous effusion in the interstices, press on the minutest bronchial ramifications, and partially obstruct the ingress of air into the cells to which they lead; whilst the viscid secretion of the mucous membrane, simultaneously inflamed, filling the caliber of the tubes thus narrowed, only yields to the air in respiration forcing its way through it in successive bubbles. This bubbling passage of air through a viscid liquid, contained in an infinity of tubes of equally diminished caliber, causes that regular and equable crepitation which constitutes the true *rhonchus crepitans**."

* Rational Exposition.

Dr GREGORY has likewise offered an opinion somewhat to the same effect. He says, "It evidently takes place in the smallest ramifications of the bronchiæ and the air-cells, and appears to be caused by the passage of many very minute air-bubbles through the viscid mucus, commonly tinged with blood, which is secreted there, and generally considered characteristic of pneumonia.*"

At first we confess we were inclined to be of the same opinion with the authors quoted; but, on more maturely considering the subject, we have been induced to support another conclusion, namely, that it is owing to the presence of a serous fluid, rather than to that of the viscid fluid usually expectorated in pneumonia; and such appears to have been the opinion of LAENNEC, when he says, "Besides the sound of crepitation, a sensation of humidity in the part is clearly conveyed. We feel that the pulmonary cells contain a watery fluid as well as air, and that the intermixture of the two fluids produces bubbles of extreme minuteness."

What, we would ask, is the condition of the lungs when they afford the *râle crepitant*? Are they not gorged with serum? Again, is this not also the case with œdematous lungs, which also afford the *râle crepitant*? and, we may add, that subintegumentary emphysema, from fractured ribs, &c. seems likewise to arise from the same

* Edin. Med. Surg. Journ. No. 104. 1830.

cause. The *râle crepitant*, it is true, is heard, in these cases, to differ much in degree, but this is well known to be also the case with it in pneumonia, it being frequently in that disease quite subcrepitating.

Besides this, there is frequently little or none of the tenacious expectoration at the commencement of pneumonia. We do not, however, mean by this to say, that the viscid fluid may not be present, but, in such cases, there is no testimony to that effect.

The proximate cause of the *râle crepitant*, except perhaps in emphysema of the lungs, where its cause is probably different, we are inclined to attribute to the bursting of very minute air-bells, formed from the admixture of air and serous fluid in the cells of the lungs; and, that this peculiar sound is produced in such a way, the following simple experiment proves.

If a vessel, containing any fluid of somewhat similar density to the serum, a glass of beer, for example, on whose surface the air-bells are very numerous and minute, be held close to the ear, a sound very similar to that of the *râle crepitant* may be heard; and this sound, more especially that of some of the fluids we have presently to mention, is a more useful illustration of the *râle crepitant*, than those already noticed; for, whenever this can be done, it is better to illustrate the sounds which occur in the chest by similar external phenomena. And

we take this opportunity of recommending, that all the comparisons made to illustrate the various thoracic sounds, be diligently studied by the young auscultator, before commencing his observations on the chest, else he will often find himself at a loss to understand the nature of many of the signs, which, had he but availed himself of the advantages accruing from a knowledge of the illustrations of these, he would at once have recognised and understood.

Although Dr GREGORY, in the paper from which we have already quoted, states it as his opinion, that the *râle crepitant* is owing to the presence of the viscid fluid mentioned, still he gives us an example, and it is probably one of the best which could be given of the crepitating *râle*, namely, that produced by *œdematous lung*. His words are,—“ It is aptly compared to the sound produced by pressing a portion of healthy, or, still better, of *œdematous lung* gently between the fingers.”

Now, we apprehend that the sound of crepitation heard in this case, as in pneumonia, can only be explained by, and is owing to, the bursting of the innumerable minute serous bubbles known to be present in such cases. It cannot here be argued that it is owing to the viscid fluid, and, indeed, the following simple experiments, while they corroborate what has already been said concerning the cause of the *râle crepitant*, also prove that fluids,

much less tenacious than that expectorated in pneumonia, produce little or no sound of crepitation; but that this is most distinct in such fluids as possess very little tenacity.

Desirous of ascertaining whether our views on this subject could be borne out by experiments, the following were instituted:—Nearly a similar quantity of different fluids, varying in density and tenacity, were introduced into bottles of the same size; and the object being to ascertain the different degrees of crepitation caused by the air-bells on their surfaces, they were successively agitated and held close to the ear. The degree of crepitation produced, varied considerably in the different fluids, as shall be stated, after these have been mentioned.

The following table contains a statement of the fluids used. The mucilage was made according to the Edinburgh Pharmacopœia. The water was not distilled.

The fluids are set down nearly according to their specific gravity and tenacity. Those above No. 3. are less, and those below greater, than the specific gravity of water. In the first two almost no crepitation was heard. In No. 3. very slightly.

In Nos. 4, 5, 6, 7 and 8, the sound very exactly resembled the râle crepitant of pneumonia. Nos. 4, 5, and 6, were probably the nearest.

Fluids used in the Experiments alluded to.

No. 1.	Æther,	$\frac{1}{2}$ oz.	to $\frac{1}{2}$ oz.	of water.	
2.	Alcohol,	1	do.		
3.	Water,	1	do.		Sp. gr. 1000.5.
4.	Mucilage,	$\frac{1}{4}$ do.	1	do.	... 1015.25.
5.	Serum of pleuritic effusion,				... 1015.5.
6.	Urine,				... 1018.5.
7.	Mucilage,	$\frac{1}{2}$ oz.	to 1 oz.	of water,	... above 1025.
8.	Serum of blood slightly tinged red.				
9.	Mucilage,	$\frac{3}{4}$ oz.	to 1 oz.	of water.	
10.	do.	1	do.	...	do.
11.	do.	1	do.	... $\frac{1}{2}$	do.
12.	do.	1	do.	... $\frac{1}{4}$	do.
13.	do.	1	do.		

It was sometimes necessary to remove the large bubbles from the surface, which was easily done by the feathery extremity of a quill, before crepitation became distinct, it depending upon the bursting of the very minute bubbles. This, however, was not always the case, and in some, the urine, and No. 4, for example, it almost never became necessary.

The sound of crepitation progressively diminished in intensity in the fluids further down the table; until, in No. 13, it was scarcely audible.

The principal inferences, then, to be drawn from these experiments, appear to be, 1st, That a very similar sound

to that of the *râle crepitant* is produced by the bursting of minute air-bubbles on the surfaces of certain fluids; 2d, That the fluids on whose surfaces it occurs most perfectly are the serous, and such as possess a somewhat similar density and tenacity.

The *râle crepitant* occurs in the first stage of pneumonia, and is pathognomonic of it; and the extent over which it is heard indicates most surely the extent of the disease. It likewise indicates the resolution of pneumonia. Dr STOKES, in a paper on Phthisis pulmonalis, comes to the conclusion, "that a recurrent crepitating rale in the same situation, with gradual increase of dulness of sound, on percussion, may be reckoned as an excellent diagnostic of the growth of tubercle*." He believes it to arise from the irritation produced in the lungs by the successive development of crops of tubercles, each in its turn producing fresh excitement. This appears to be an important observation, and one which may be beneficial in practice.

A modification of this rale is found to take place in œdema of the lungs, and sometimes in pulmonary apoplexy, around the space occupied by the effused blood; but, when the history and general symptoms are considered, there is little chance of confounding these dis-

* Trans. of King's and Queen's College of Physicians, Dublin, 1828.

eases, either with one another or with pneumonia. This modification of the *râle crepitant* has been termed *Sub-crepitating*. We have an idea that the different degrees of the *râle crepitant* depend upon the number of the air-bubbles, which we have sometimes observed to be more numerous, and crowded together, in particular portions of lung, in the first stage of pneumonia, than in purely œdematous affections of this organ.

The *râle crepitant* is occasionally heard in cases of emphysema of the lungs, but it is a very rare phenomenon; the want or feebleness of the vesicular respiration being a much more common sign. It gives, according to LAENNEC, “an idea of a drier sound, than those already described, is heard during inspiration, and conveys the impression of air entering and distending lungs which had been dried, and of which the cells had been very irregularly dilated; and entirely resembles the sound produced by blowing into a dried bladder.” It is a pathognomonic sign of vesicular, and more especially of intervesicular emphysema. It is more distinct in the latter, and is probably caused by the entrance of the air into the enlarged or united cells, intervesicular spaces, or subpleural texture. A similar sound is heard in subcutaneous emphysema, on pressing interruptedly with the ear on the stethoscope, or with the finger in the vicinity of the affected part.

The signs described are only present in extreme, and consequently rare, cases of emphysema; but there is another sign, still more rare, which has been termed by some the "murmur frictionis." LAENNEC terms the same the sound of friction of ascent and descent, and describes it as a dull sound, such as would be produced under the stethoscope by friction of the finger against a bone, and farther conveying the sensation as of a body rising and falling, and at the same time rubbing somewhat harshly against another. It is only distinct during deep inspiration, and is, in most cases, caused by interlobular emphysema of the lungs. More rarely, says Dr WILLIAMS, this sound resembles the friction of a pulley, or that of two pieces of leather rubbed together, and is usually confined to inspiration.

These signs, as already stated, are rarely present in emphysema of the lungs, by far the most usual sign of this disease being the absence or diminution of the sound of the vesicular respiration, while at the same time the percussion is good, or louder than natural. Besides, there is, in general, a slight sibilous or sonorous rale accompanying this diminution of the vesicular respiration, which may be considered as the consequence of a catarrhal affection accompanying it.

II. *The Sibilous Rale.*

This rale, says LAENNEC, is sometimes like a prolonged hiss, flat or sharp, dull or loud. Sometimes it is very momentary, and resembles the chirping of birds, the sound emitted by suddenly separating two portions of smooth oiled stone, or by the action of a small valve. These varieties often exist together in different parts of the lungs, or successively in the same part. The peculiar nature of the sound, and appearances on dissection, seem to prove this rale to be owing to minute portions of very viscid mucus, obstructing more or less completely the small bronchial ramifications. This applies more especially to the variety resembling the elieking sound of a valve, which is indeed only a variety of the mucous rale. The kind more strictly sibilous, is probably occasioned rather by a local contraction of the small bronchi, from thickening of their inner membrane.

Dr WILLIAMS believes that the sibilous rale is caused in the way mentioned by LAENNEC; and that the form and size of the isthmus, or contracted point, will determine the nature of the sound. Thus, continues he, we often hear an acute whistling sound, and as we know that such a sound may be produced by air passing

through a small aperture, it may be supposed that a contraction of this kind causes it in this case*.

A very similar sound to the sibilous rale, and at the same time possessing that variableness so characteristic of it, is produced by the simple experiment of respiring slightly by the openings between the teeth, those of the upper jaw being placed in contact with the lower lip. That this phenomenon may take place, however, it is also necessary that a minute quantity of saliva be present at the time, which is generally the case.

This very simple experiment seems an additional proof that the râle sibilant is produced somewhat in the way already mentioned. Sounds are likewise sometimes produced in this manner, very like the sonorous rale.

The sibilous râle is occasionally heard in the first stage, of what LAENNEC has termed the acute mucous catarrh; it is also present in the pituitous catarrh, and slightly in the dry catarrh of LAENNEC, in which also, though more rarely, the clicking sound of a valve is heard. The extent of the chest over which it is heard denotes the extent of the disease.

III. *The Sonorous Rale.*

This has been compared by different authors to various

* Rational Exposition.

sounds: LAENNEC compares it to the snoring of a person asleep, the friction of a bass string, or the cooing of a wood-pigeon. Dr WILLIAMS, in addition to these, compares it to the buzzing of an insect, and the bass note of a violincello or bassoon.

All these sounds have a general resemblance; and yet vary considerably, but principally only in degree. The sonorous rale, then, is exceedingly variable.

LAENNEC is probably right when he attributes this rale, in most cases, to the contraction of considerable bronchi, caused by the pressure of an enlarged gland, or circumscribed spot of inflammation,—presence of a tenacious clot of mucus,—or local thickening of the mucous membrane. Dr WILLIAMS believes it to be caused by a flattened contraction of the bronchi, by which little or no gaping aperture is left; hence the air, in passing, is thrown into sonorous vibration, after the manner of the reed of the hautboy, or the lips in blowing a horn or trumpet.

LAENNEC considered it difficult to explain the reason why the key of sound became flatter, instead of sharper, as might be expected from the contraction of the aperture. At the same time, he states, that in the analogous case of thickening of the membrane of the larynx and glottis, the voice becomes hoarser and flatter than natural; but if the circumstances mentioned in consider-

ing the cause of the modulation of tone in excavations, be taken into account here, the difficulty will, perhaps, be much removed.

This is a catarrhal rale, and is heard in the first stage of the mucous catarrh, and in the pituitous catarrh of LAENNEC.

IV. *The Mucous Rale.*

This rale takes place most usually in consequence of an accumulation of mucus in the trachea and bronchi, hence its name; but it also occurs from the presence of other fluids besides mucus in these tubes; as blood, pus, softened tubercular, and broken down gangrenous matter. It also occurs from the presence of these fluids in excavations of the lungs, but is then generally termed Cavernous.

The mucous rale is essentially caused by the transmission of air through the liquids mentioned, producing a noise proportioned to the frequency of the respiration, quantity, and quality of the fluid present, and diameter of the tubes or excavations in which it occurs.

LAENNEC compares the sound of the mucous rale to the impressions which we receive by blowing through a pipe into soapy water; and, continues he, when it exists

at once copious, large, and constant, it is sometimes so noisy as to resemble the rolling of a drum.

Mucous rale is always greater, the more profuse the quantity of the fluid and the greater the diameter of the bronchi in which it occurs; provided always that the air mixes itself considerably with it. The mucous rale of the larynx may be taken as a tolerably good example of that perceived in caverns; and thence termed Cavernous Rale: the former, however, is perhaps louder.

Cavernous rale is generally circumscribed, and, in some cases, requires the effort of coughing to produce it, the consistency of the contained fluids being sometimes very great, and the communications with the bronchi few, and occasionally blocked up; so that, in suspected cases, many trials are often necessary before coming to a conclusion as to the existence of caverns from such an indication. The rale, however, which is heard in pulmonary excavations is generally very loud, and amounting to what the French authors term "gargouillement," the English "gurgling;" and when this rale is heard elsewhere than in the trachea and very large bronchi, it is an additional evidence to the other signs already or hereafter to be mentioned, of the existence of an excavation in the lungs. The nature and cause of the excavation is only to be learned from the general symptoms and history of the case.

The mucous rale exists principally in chronic pulmonary catarrh, and in the last stage of the acute mucous. It is also present in hæmoptysis; and the cavernous variety, in excavations formed by softening of the tubercular matter, in phthisis—abscess of the lungs—gangrene; in cases of dilatation of the bronchi, with catarrh; and indeed wherever there exists a cavern in the lungs, containing liquid and air, and communicating with the bronchi by an opening below the surface of the fluid. In the latter, as already mentioned, it is circumscribed, and usually accompanied with some of the other signs indicative of the existence of an excavation. In the former, it is generally more diffused, but indicates equally in both the extent of the disease, and, to a certain degree, the quantity of the fluid present in the lungs.

We shall conclude the consideration of the rales with the following general remarks of LAENNEC on this subject. All the rales, says he, are more evident during coughing than during respiration. Besides the sound of the rale, there is also noticed a slight vibration communicated to the cylinder, when the seat of the phenomenon happens to be immediately beneath it*; usually strong in the mucous and sonorous, less in the crepitous, and still less in the sibilous rales. When the rale has its seat re-

* This may sometimes be felt by the hand placed on the chest.

mote from the point where the instrument rests, although heard very strongly, no vibration is felt; and when vibration cannot be discovered, we may conclude that the cause of the rale exists in the central parts of the lungs.

Some of the rales, especially the mucous and crepitous*, cannot be distinguished at the distance of more than one or two inches from their site; others can be distinguished frequently through the whole width of the chest, and are thus often combined with the former. The rales, taken singly, are very inferior diagnostic signs to those supplied by the auscultation of the respiration and voice. Conjoined with other signs, however, they become extremely valuable. The two crepitous rales, and more especially the cavernous, are, in general, more certain than any other†.

SECTION III.

AUSCULTATION OF THE COUGH.

BEFORE or after the effort of coughing, a sudden and deep inspiration is generally made, and in this consists the chief value of such a sign; all the phenomena which de-

* This depends entirely, of course, upon their intensity, which varies.

† Mediate Auscultation.

pend upon respiration being, in consequence, rendered more evident. It is therefore useful to cause this effort to be made in any case in which the sounds are feebly marked, but it ought never to be done so as to exhaust the patient; one or two trials are, in general, sufficient.

There is another point to be attended to in the auscultation of the cough, which is the strength of the shock or impulse communicated by it to the lungs and parietes of the chest. This, in the situation where the vesicular respiration is heard, is very slight; more distinct where bronchial respiration occurs; and still more so where tracheal respiration is heard. Along with the shock there is a considerable sound, and the louder in proportion to the strength of the impulse. The different degrees of impulse and sound may, from the situation in which they are perceived, be termed Vesicular, Bronchial, and Tracheal. A knowledge of these, it is evident, can only be obtained by reference to a healthy chest. They are indicative of a healthy state of the contained parts.

According to the general law, in regard to the transmission of sound by the lungs, when these, from any cause, become condensed, provided the larger branches of the bronchi be pervious to the air, the sound, as well as shock, are more perfectly transmitted; so that in situations where the vesicular cough naturally is heard, the bronchial may be developed; and this happens in

pneumonia, from hepatization, in tubercular or other deposition in the lungs, and in all cases where there is condensation of the pulmonary texture, or when the bronchi have become moderately dilated, which, however, can scarcely happen without the vesicular structure being slightly compressed.

The cough may become tracheal in the regions where naturally vesicular or bronchial; and this is an additional evidence of the existence of an excavation in the lungs communicating with the bronchi. In such cases, the cough resounds as it does in the larynx or trachea, and is in some cases disagreeably loud. This variety, from its indication and cause, is termed the Cavernous Cough: it most commonly occurs in tubercular excavations in the lungs, which contain a considerable quantity of air.

All the sounds heard during the act of respiration, whether healthy or diseased, pure, or mixed with rales, are, for the reasons already stated, always made more manifest, by having recourse to the act of coughing.

Coughing is otherwise advantageous; it often removes obstructions from the blocked up bronchi, and thus enables us, in cases of catarrh, to hear the sound of respiration, where we could not before; and the curious phenomenon, termed Metallic Resonance, is in general most distinct after coughing, but it is the shock alone which seems useful in causing its development.

LAENNEC says, that in deducing our indications from the effects of coughing, certain precautions are necessary. Sometimes a violent cough gives rise to no rale, though the other circumstances proper for its production are present; and at other times, in timid patients, the cough seems to be confined to the throat, and excites no resonance in the bronchi; in which case he recommends that the patient be desired to cough, after taking a deep inspiration.

SECTION IV.

AUSCULTATION OF THE VOICE.

THE resonance of the voice in the lungs in health, differs according to the different parts examined; and, in disease, according to their morbid condition; thus affording a very good indication of the state of these.

The different modifications of sound produced by the voice, may be considered in the following order:—The Natural Resonance, transmitted by the Vesicular Structure; Bronchophony; Laryngophony; Pectoriloquy; and Ægophony.

The easiest method of performing the auscultation of the voice, is to cause the patient to count slowly, dis-

tinctly, and loudly, if possible; or, what is better, questions may be put relative to the condition of the patient.

I. *Vocal Resonance, transmitted by the Vesicular Structure.*

In consequence of the vesicular structure being a very bad conductor of sound, we would naturally expect that the transmission of the voice by it would be very imperfect, which is accordingly the case. In general, during speaking, a slight resonance may be heard; but this is, in some cases, very slight, and indeed occasionally almost imperceptible when the voice is weak. It somewhat resembles the slight vibration which is felt on the application of the hand to the thorax of a person speaking, only a slight kind of murmuring resonance being heard at the extremity of the stethoscope.

This sound is heard in the same situations, where vesicular respiration is perceived; and also indicates a healthy state of the lungs. Various morbid changes are in general denoted by the absence or the increase of this sound, and these we shall presently notice.

The cause of this feeble resonance undoubtedly is the transmission of the sound of the voice from the larynx, along the trachea and bronchial tubes, which becomes more and more diffused and weakened, as the divisions of the bronchi become more minute, and less able to conduct it.

II. *Bronchophony.*

The resonance of the voice is found to be much greater in the neighbourhood of the larger branches of the bronchi, than in the vesicular structure of the lungs; and it is from this circumstance that the sign we are now about to describe has derived its name. The sound of the voice, says LAENNEC, in Bronchophony, rarely seems to traverse the stethoscope; but it is found to resound so loudly at its extremity, as to be more readily heard through the instrument, than the voice from the mouth is heard by the other ear. Bronchophony to such an extent, however, takes place for the most part only at the roots of the lungs.

Bronchophony is generally most distinct in children, females, thin persons, and such as have an acute voice; and, indeed, we may here remark, that all the phenomena depending upon the voice are most distinctly heard in such persons. On this subject Dr WILLIAMS has the following very ingenious remarks:—"The vibration of deep notes," says he, "cannot be extended to very narrow tubes, because there is not space for their play; and this explains the difference resulting from the tone of voice, and suggests that a change of tone in the same individual may considerably vary the bronchophonic re-

sonance." This is a very useful suggestion; and, in many cases, renders auscultation of the voice much more satisfactory than it otherwise could be, and in all the modifications of sound produced by the resonance of the voice.

What we have just described is the bronchophony which occurs in healthy persons; it is caused by the transmission of the sound of the voice through the larger bronchi; it occurs in the same regions as the bronchial respiration, and is an indication of a healthy state of these parts.

We shall now turn our attention to the presence or absence of this phenomenon, as an indication of disease.

The resonance of the voice may become bronchial, where it naturally is vesicular, or it may be absent, where it naturally should be present. The former will happen, whenever any morbid alteration of the lungs causes these to become better conductors of sound, whereby the resonance of the voice in the larger bronchi of the part, smothered naturally by the vesicular structure, is rendered evident, and will of course be more distinct, as the condensation happens in the neighbourhood of large bronchi, especially when these are near the surface.

Bronchophony and Pectoriloquy, of which we shall presently speak, are degrees of the same sound. LAEN-

NEC, however, observes, “that they are rarely so like as to deceive one of moderate experience; the tone of the former is somewhat like that of a speaking-trumpet, and is more diffused than that of pectoriloquy.” But it must be confessed, that, notwithstanding all that has been said as to the distinctive characters of each, it is impossible to distinguish very perfect bronchophony from imperfect pectoriloquy; they are, in fact, the same.

Bronchophony is present in hepatization of the lung, in condensation from tubercular or other deposition, in cases of moderate dilatation of the bronchi, and of small cavities existing in the lungs. It is sometimes absent, or altered, in certain situations where naturally present, in cases of effusions into the chest, solid, liquid, or aëriform.

III. *Laryngophony.*

This is merely an increased degree of bronchophony. It, however, has some tolerably distinct characters of its own. In bronchophony the sound of the voice is heard to resound loudly at the extremity of the stethoscope; in laryngophony, however, the sound of the voice, to use the words of LAENNEC, traverses the tube of the stethoscope, and prevents the unarmèd ear from hearing that issuing from the mouth; in other words, it is much louder and more distinct. This phenomenon is heard in the

same situations as tracheal respiration, and indicates, when there alone, a healthy state of these parts. When absent, or heard in situations where it is not naturally present in health, it indicates the existence of a considerable change in the state of the contained parts, which we shall immediately notice when treating of Pectoriloquy.

The cause of this phenomenon is very evident, from what Dr WILLIAMS has said on the subject. "We hear the voice," says he, "through the instrument, and louder than by the other ear, inasmuch as the voice is outwardly diffused in a large space, but there," alluding to the trachea, "confined to a narrow tube." This explanation of Dr WILLIAMS seems undoubtedly the true one; hence the reason why the sound is conveyed more perfectly along the stethoscope from the trachea or larynx, than by the air, to the other ear.

IV. *Pectoriloquy.*

There is, says LAENNEC, an almost perfect identity of effect between Pectoriloquy and the sound of the voice as heard through the tube resting on the larynx; and the experiment offers an excellent mean for giving us an exact notion of the phenomenon, when we have not the proper subjects for observation. The identity of this sound with laryngophony is exceedingly useful, for the

latter can always be referred to by the learner as a standard of comparison in cases of doubtful pectoriloquism.

This strong resonance of the voice, when found to occur in situations where it does not exist in health, is, in general, a sure sign of the presence of an excavation in the lungs, containing at least some air, and communicating with the bronchi. It occurs in other rare cases, which we shall afterwards mention.

LAENNEC divides this phenomenon into two varieties, according to its intensity and completeness, and he denominates the different degrees by the terms Perfect, and Imperfect. It is considered as perfect, when the transmission of the voice through the stethoscope is complete, and when it, as well as the corresponding results obtained from the exploration of the cough and rale, are exactly circumscribed; and indeed it cannot be too deeply impressed upon the student in auscultation, that without the evidence of the other signs, in general accompanying pectoriloquy, this of itself, except when very well marked, is of comparatively little value as an indication of a cavity in the lungs; but, when combined with these, there is no sign more to be trusted. By attending to such precautions many mistakes may be avoided.

Pectoriloquy is imperfect, says LAENNEC, when some one of these characteristics is wanting, and particularly

if the transmission of the voice be not evident ; and it is doubtful in cases where the voice is very feeble.

Pectoriloquy is caused by the resonance of the voice in an excavation in the chest, containing air, and communicating freely with the bronchi. It is found to take place most generally in excavations formed by softened tubercles in the lungs, gangrene, or abscess ; by the evacuation of a cyst into the bronchi ; probably in the rare case of an abscess in the mediastinum, communicating with the bronchi ; and in the case of a circumscribed adhesion of the pleura pulmonalis to the pleura costalis, so as to form a small cavity, communicating with the bronchi. It also takes place in cases of extreme dilatation of the bronchi.

Pectoriloquy is always most perfect in a moderately sized cavity, perhaps of about $1\frac{1}{2}$ or 2 inches in diameter, whose parietes are smooth and firm, and which at the same time communicates freely with the bronchi by considerable openings, such as would perhaps admit a goose-quill. The proximity of the cavity to the surface of the lung, and more especially when this is adherent to the parietes of the chest, together with emptiness of the cavity from fluid or more solid matters, render the pectoriloquy more perfect. Acuteness of the voice is also of great consequence for the perfect development of the phenomenon ; and it will be found very advantageous, in

doubtful cases, to cause the patient to raise the tone of the voice.

In cases where the voice is very weak, or where, from an affection of the larynx, this is reduced to a whisper, there can be little or no pectoriloquy; but, in such cases, we hear, in general, a kind of puffing after every syllable. Pectoriloquy is less distinct in a very large cavity, in one the size of the fist, for example, than in a smaller one; or when the cavity is deep seated, particularly with a stratum of healthy lung between it and the surface; such being a bad conductor of sound.

Doubtful pectoriloquy is, in general, that which is first observed, and this most usually after bronchophony; and indicates the softening and evacuation of the morbid matters in the lungs. By degrees it becomes more perfect, as the excavations, from whatever cause, become more empty and extended, at least within certain bounds, as already mentioned; at last becoming quite perfect, when the cavities contain little else than air, and the parietes of these have become dense and smooth.

Pectoriloquy sometimes suddenly ceases to be heard where shortly before it had been distinct; and this, from the experience of LAENNEC, sometimes continues even for days. It is not difficult to assign a correct reason for this cessation, when we consider the profuseness of the secretion, and the softening of the parts which usually

accompany such cases. It is certainly, as LAENNEC has said, caused by the temporary obstruction of the bronchial communications with the cavities; and this likewise accounts for the absence of respiration in many cases of catarrh, for such obstruction must occasionally interrupt the continuity of all the sounds which depend upon the transmission of the air or voice through the bronchial tubes, or cells of the lungs. To discover the cause of any cavity made known to us by auscultation, we must look to the other signs and symptoms.

V. *Ægophony.*

This phenomenon is one of great importance, from the results which it makes known to us; but, at the same time, it is one of the most difficult to be recognised of all stethoscopic signs, which proceeds entirely from its great and generic resemblance to the preceding phenomenon, bronchophony; and indeed it may be said to be a modification of this, altered by certain circumstances, which we shall presently notice.

It is always well, in the nomenclature of the phenomena made known by auscultation, to combine as much as possible a description of their characteristic peculiarities, for these will always be better remembered in this way. This has been done with respect to ægophony by LAENNEC, who has compared it to the trembling

and bleating sound of the voice of the goat, (from *αἴγος* a goat, and *φωνή* the voice); a characteristic, he adds, which is the more striking, because the key or tone of it approaches that of this animal's voice.

“Ægophony consists,” says LAENNEC, “in a peculiar sound of the voice, which accompanies or follows the articulation of words; it seems as if a kind of silvery voice, of a sharper and shriller tone than that of the patient, was vibrating or floating on the surface of the lungs, sounding more like the echo of the voice, repeating the words or their final syllables in a small, sharp, and tremulous key.”

Ægophony essentially depends upon the transmission of the voice from the lungs, through a thin stratum of fluid interposed between these and the parietes of the chest. It is this which is the cause of the peculiar change in the nature of the sound, so well described by LAENNEC; and indeed he performed an experiment to prove it. He applied a bladder half filled with water between the scapulæ of a young man, who presented a well marked natural bronchophony in this point, and found that a similar sound to that of ægophony was heard; the bronchophonic resonance being altered by transmission through the fluid.

Depending, then, upon an effusion of fluid into the chest, there will necessarily be accompanying this, a

certain degree of compression of the pulmonary texture, which is believed to be necessary for the proper development of ægophony; and in situations where the natural bronchophony is great, or where there is condensation from any cause, it will be well marked, as in cases of pleuro-pneumonia.

The voice heard through the stethoscope in ægophony, as well described by Dr WILLIAMS, is rendered squeaky and wiry, and is constantly and considerably raised. It is most evident when the voice is acute, but we must be on our guard lest we mistake the sharp resonance of this for ægophony itself, which might happen, particularly if we forget to compare both sides of the chest.

Ægophony is more apt to be confounded with bronchophony than with pectoriloquy, because the former is diffused, and so is ægophony. Like it also, it is more distinct, as the bronchi are large and numerous; so that, instead of saying with LAENNEC, that ægophony may be combined with bronchophony, we would rather say, that, having for one of its causes the bronchial resonance, it will be more or less complete, or altered, by the particular states of the bronchial tubes. Hence the varieties of ægophony, which LAENNEC compares to the following phenomena, as giving a good idea of them: 1st, The sound of the voice through a metallic speaking trumpet, or cleft reed; 2d, That of a person speaking with

something between the lips and teeth; 3*d*, The nasal intonation of the juggler, speaking in the character of Punch. All these occur in situations where the natural bronchophony is great.

Ægophony is present in cases of moderate effusion of a mobile fluid into the pleura; and it has been observed by LAENNEC, where the fluid did not exceed a few ounces, three or four. In such cases it is usually heard for a little way above and below the nipple, in a zone around the chest; but, when the effusion is very profuse, it is only heard at the roots of the lungs, where the quantity of fluid is necessarily less, between the lung and parietes of the chest, than at any other part. It is useful to know that the respiratory murmur is in general audible where ægophony is heard.

Before concluding this subject, we shall quote LAENNEC's excellent recapitulation of the peculiarities of ægophony in pleurisy. It is to the following effect:—"1. That ægophonism appears about the period when the effusion begins to be somewhat considerable, when the sound on percussion becomes dull, and the respiratory murmur fails in the affected side; 2. That it disappears when the effusion becomes very abundant; 3. That it may continue during several months, when the quantity of fluid remains stationary; 4. That, after having disappeared, it reappears upon the quantity of effu-

sion being lessened; 5. That it goes off entirely when the fluid is altogether or nearly absorbed. I would also repeat, that the site of the phenomenon appears to be the upper or thinnest part of the layer of effused fluid; that, where it is present, we frequently observe bronchial respiration and bronchophonism; and, finally, that when it is perceived over the whole or greater part of one side, it indicates a moderate quantity and equable diffusion of fluid over the whole surface of the lung. In this case we also perceive, almost everywhere, some remains of the respiratory sound, the effusion being insufficient to compress the lung sufficiently to exclude the air from it; and, should things remain in the same state during the whole continuance of the disease, we may be assured that the lung is retained at a small distance from the ribs, by means of adhesions on different points of its surface. *Ægophonism* is never wanting in the beginning of pleurisy, in cases wherein the pleura had been heretofore quite sound; and the only thing which occasionally prevents its being manifest, are previous adhesions over a great portion of the lung. It never fails to reappear in acute cases, which are rapid in their progress, when the effusion is sufficiently diminished; and it is more marked according as this has been of short duration. But, in chronic cases, and even in acute cases wherein the absorption is slow, this renewed *ægopho-*

nism is much less perceptible, and sometimes is entirely wanting."

Ægophony, then, occurs in cases where there is a liquid effusion into the sac of the pleura, and is a very sure indication of the presence of such effusion.

SECTION V.

AUSCULTATION IN CASES OF PNEUMOTHORAX.

METALLIC Tinkling, Metallic Resonance, and Amphorique Respiration, appear to have been considerably confounded together, and have been looked upon more as modifications of each other, and depending upon similar causes, than as diagnostic of different morbid lesions. In the following pages we shall endeavour to separate them, and to shew the distinct causes and indications of each.

The sounds heard in cases of simple and compound pneumothorax, that is, with or without liquid, or communication with the external air, are five in number: I. The familiar sound produced by the falling of a drop into a liquid. II. The sound like that produced by striking a glass with a pin, &c. III. The ringing sound heard after coughing or speaking. IV. The amphorique re-

spiration. V. The splashing or fluctuating sound, produced by succussion. We shall consider each separately.

I. The first sound, resembling the dropping of a fluid, we have no hesitation in attributing to the occurrence of the fact itself within the chest.

This peculiar and familiar sound seems to depend on the production of one or more air-bells on the surface of the fluid, at the moment the drop comes in contact with it. These, however, are by no means invariably produced; the drop frequently falling silently, without the production of air-bells, as any one may satisfy himself by experiment.

That this sound is rare, then, is not much to be wondered at, when we know the circumstances necessary for its development. LAENNEC mentions only one case where it was heard. He says, "Having the cylinder applied to the chest, below the left clavicle, as the patient placed himself in a sitting posture, I heard distinctly a sound like that produced by a drop of liquid let fall into a flask containing a very small quantity of water; and this sound was followed for a second by a tinkling, such as is occasioned by striking a glass with a pin. Neither the voice, cough, nor respiration, was attended by any sound of the same kind."

In the chest "there was nearly a pound of a liquid

resembling whey, of a whitish colour, turbid, and containing portions of yellowish half concrete albumen: it was quite covered with transparent bubbles, exactly resembling those produced by agitating or blowing into soapy water *.” No fistulous communication with the bronchi is mentioned.

This peculiar dropping sound does not depend at all upon the voice, cough, or respiration, for its production; but is probably for the most part called into existence by the motion of the patient, as in the case just mentioned. It is a very sure indication of the presence of air and liquid in the chest; but these, from what has been remarked concerning the circumstances necessary for its production, may be present without the manifestation of such a sign. In fact, there may actually be dropping of fluid in a pneumothoracic cavity without such being made evident by this sign.

It is therefore not an invariable, and consequently by no means so valuable, a sign of pneumothorax as others to be described.

II. The second sound, like that produced by striking a cup of metal, glass, &c. with a pin, is what we shall next consider.

It appears to us that it is to this peculiar sound LAEN-

* Med. Auscult., Case xliii.

NEC has given the name of “Tintement Metallique,” or Metallic Tinkling; and to it we propose to confine the term. The descriptions he has given of it are very appropriate; but still they do not in the least lead to a knowledge of its physical cause, nor of course to a knowledge of the morbid condition of the parts involved. It is always advantageous, however, when the sounds heard within the thorax can be illustrated by similar external phenomena, with regard to which there is no doubt.

For these reasons we are inclined to object to the term *metallic* in speaking of pneumothoracic sounds generally, as tending to mislead those setting out in their inquiries; and we hope to be able to shew that quite as perfect, perhaps even more perfect, illustrations of the different sounds, can be obtained by a reference to other phenomena, than those which are found to take place in metallic bodies. Moreover, the illustrations to which we mean to refer will at once declare the state of the parts; being, in fact, just similar external occurrences.

In this way, it appears to us that a knowledge of the subject will be far more easily obtained, and the particular morbid conditions found in connection with the various sounds, more easily remembered. For example, the familiar sound just considered, that of the dropping of a fluid, is much better illustrated, and the state of parts indicated, by a reference to the same external occurrence,

than it could be by a reference to any other sound, which did not require air and liquid for its production : its physical cause is at once evident, and the state of parts declared. We do not, however, propose to change the terms, they being in such general use.

The peculiar sound which has been likened to the striking of a glass with a pin, &c., we believe to be owing to the bursting of considerable air-bells on the surface of the liquid in the chest. Any one may satisfy himself of the fact of the resemblance of this sound and that mentioned, by the simple experiment of agitating a small quantity of liquid in a bottle of a considerable size, and then placing his ear close to it. The sound is generally perceived after the bursting of every large air-bell. A slightly mucilaginous fluid is best for the purpose.

In the case just noticed, it is said that the dropping sound was followed for a second by the “ tintement métallique.” Now, we formerly stated that the dropping sound depends upon the production of one or more air-bells on the surface of the fluid ; consequently the circumstances which we believe to be necessary for the production of this phenomenon were present, namely, one or more air-bells ; the bursting of some of which immediately after their formation is highly probable. Besides, the appearances after death proved the existence of air-bells on the surface of the fluid. This appearance, how-

ever, may, in part, be attributed to incipient decomposition of the liquid, as it was said to have been entirely covered over by them.

Air-bells are frequently found on the surface of the liquid of pneumothoracic cavities, probably, for the most part, the consequence of decomposition. In such cases the air-bells will afford the necessary means for the production of this peculiar sound, which is more frequent than will permit us to state the bursting of air-bells produced by the dropping of a fluid, as its most usual cause.

LAENNEC mentions another case, which is favourable to the idea of the "tintement métallique" being caused by the bursting of air-bells. The following is an extract from it:—"Tintement métallique audible on right side. Chest punctured, and two pounds of matter flowed in twenty minutes. This matter was puriform, opaque, of a slightly greenish-yellow colour, and scarcely fetid. As it flowed it was intermixed with some air-bells. Immediately after the operation, the tintement métallique was heard much louder than before. After death 2 lb. more of fluid were found, and fistulous openings, of from one to three lines in diameter *."

In this case, then, the "tintement métallique" was found to co-exist with the presence of air-bubbles. The fact of its being heard louder than before, is explained

* Med. Auscult., Case xxxviii.

by the increased size, from the displacement of the liquid, of that portion of the cavity containing the air; and this is generally the case with all pneumothoracic sounds.

Succussion of the chest—violent coughing—and the opening of fistulæ below the surface of the liquid, may likewise be occasional remote causes of this phenomenon, by causing the production of air-bells.

The “*tintement métallique*” occurs quite independently of the voice, cough, or respiration, and indicates the presence of liquid and air in the chest. Both, however, may be present without it, the circumstances necessary for its development being absent.

III. We have next to consider that peculiar sound heard after coughing and speaking, or what has been termed *Metallic Resonance*, and this is by far the most frequent sign heard in pneumothorax.

A very exact notion of this sound, which is not more allied to the metallic than any other of the pneumothoracic sounds, may be obtained by the simple experiment of blowing suddenly, speaking into, or tapping upon, any large vessel with a narrow mouth, containing merely air, liquid not being at all necessary for the production of this sound*. After either of these acts, particularly after the

* A sound of exactly the same character, only much louder, is distinctly heard on blowing into the bung-hole of a barrel.

two former, a peculiar ringing sound is distinctly perceptible; and this, according to Dr WILLIAMS, is owing to the sonorous vibrations being repeatedly reflected from the parietes of the cavity, and the smoother and more regular these are, so is the sound more perfect and clear.

The metallic resonance is heard, in general, after speaking, sometimes after every word or syllable, when these are distinctly and very audibly spoken. It occurs also after coughing, and is then most distinct. It is possible also to conceive its presence to a slight extent, in cases where there is dropping of a liquid, even when the peculiar sound dependant upon the evolution of air-bells is not present, by the slight vibration which is produced in the air contained in the cavity; and we know from experiment, that such a resonance is thus produced.

It is in cases of pneumothorax in which there is communication with the bronchial tubes, above the surface of the fluid, when present, that this sound is most distinctly, or at least most usually heard; and it is caused by the sudden puffing of the air into the cavity, during coughing or speaking. It is likewise, however, heard, as shewn by Dr WILLIAMS, (and LAENNEC gives an instance, which seems to prove the same thing), in cases where there is no communication with the bronchial tubes. In the case alluded to, LAENNEC says, "When the patient spoke, a distinct tintement was perceived:"

and, again, " It is worthy of note in this case, that there was no fistulous communication between the pleura and bronchia; and, consequently, that the tinkling sound could only be produced by the vibration occasioned by the resonance of the voice in the lung; which latter, it is farther to be observed, was greatly compressed, and covered with a strong false membrane*."

In consequence of considering the different pneumothoracic sounds more as modifications of each other, and depending upon similar causes, than as distinct in origin and indication, even LAENNEC occasionally seems to confound these; and this, with all deference, we think seems to have been the case here. By the term Tinkling, in this instance, we believe is rather to be understood metallic resonance, than " tintement métallique." The former is very unlike the sound produced by striking a glass with a pin, to which the latter is compared; besides, LAENNEC himself says, that the " sound could only be produced by the vibration occasioned by the resonance of the voice in the lung," just as a similar phenomenon is produced by tapping upon the chest, in some cases of pneumothorax, either during life or after death.

The metallic resonance indicates the presence of pneumothorax, but, whether simple or compound, it cannot

* Med. Auscult.

be said to give any definite information. From what has been said, however, it may be inferred, that, generally, in such cases, a fistulous communication with the bronchial tubes is present, though certainly not indicated.

When the metallic resonance is heard, without the efforts of speaking or coughing, but probably caused by the effects of the comparatively silent drop, the presence of liquid may be presumed; but we do not know of any case in which such an observation has been made.

IV. The next pneumothoracic sound to be noticed, is the *Amphorique Respiration*. Of this, however, we shall say little here, having considered it fully in a former part of this Essay. It is caused in pneumothorax, as formerly stated, by the passage of the air into, and out of, the cavity, by one or more openings, communicating with the external air, either by means of the bronchial tubes, or otherwise; and is the only certain sign of the existence of such a communication. But unless the opening be above the level of the liquid, when this is present, the phenomenon, of course, cannot take place.

V. The sound produced by succussion, is the last of the signs to be noticed, whereby pneumothorax can be discovered. It consists of the familiar splashing or fluctuating sound, which has been aptly compared to

that produced by shaking suddenly a large bottle, containing a small quantity of fluid.

“To enable us to hear this sound,” says LAENNEC, “it is not necessary to shake the body much; all that is required being merely to shake the shoulder pretty quickly, and stop all at once.”

It can in general be heard without the use of the stethoscope. The sound and its site, however, are always more evident, when the stethoscope is used, or when the ear is closely applied to the chest, while succussion is performed.

The conclusions to be drawn from what has been said, appear to be the following :

I. When the familiar sound of the dropping of a fluid is heard, liquid and air are indicated.

II. When the sound like that produced by striking a cap of metal, &c. with a pin, or the “tintement métallique” is heard, liquid and air are also indicated.

III. When the ringing sound, or what has been termed the Metallic Resonance, is heard after coughing or speaking, air only is indicated.

IV. When amphorique respiration is heard, the existence of air in the chest, and one or more communications with the external air, are indicated.

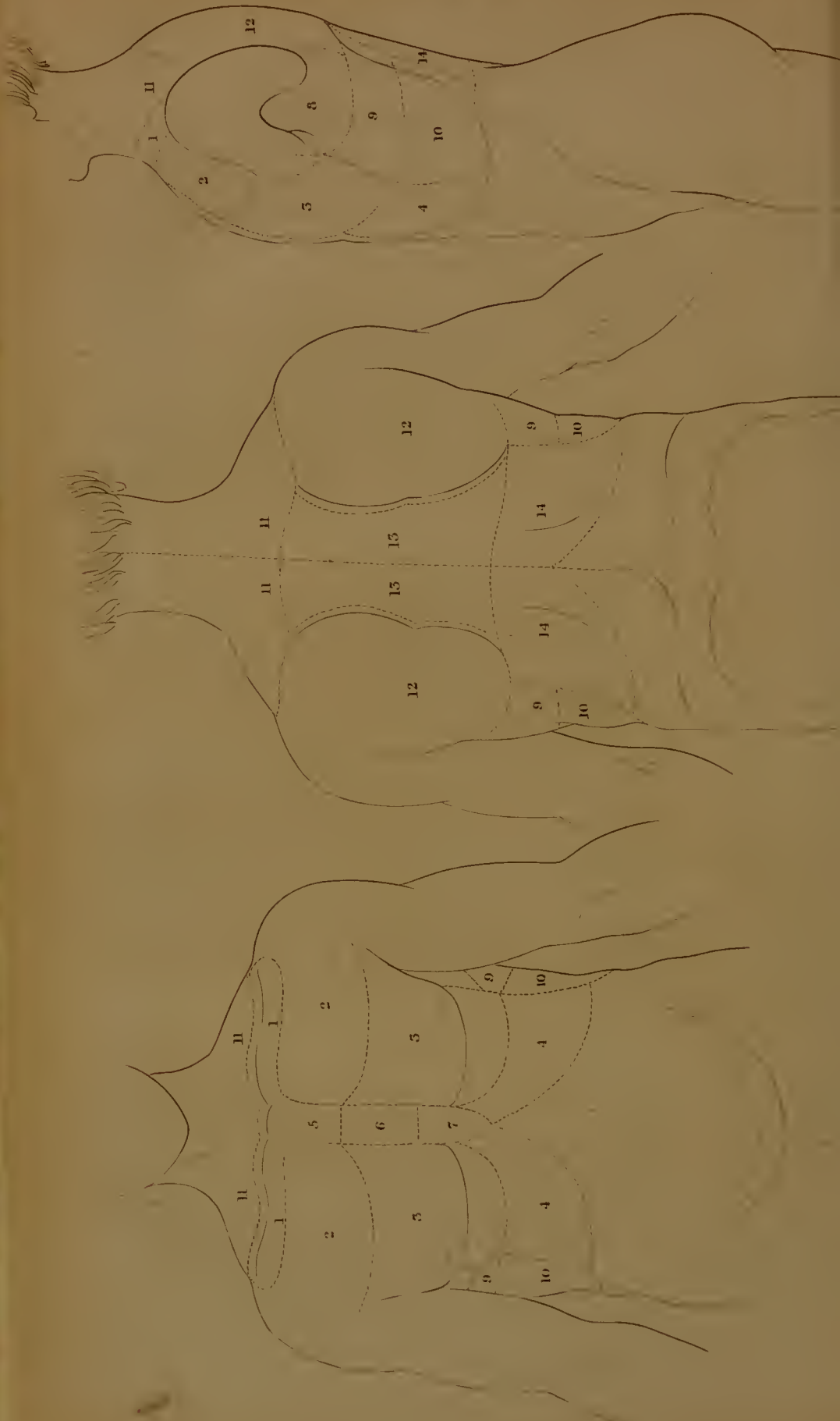
V. When succussion elicits the splashing or fluctuating sound described, liquid and air are indicated.

TABULAR VIEW OF THE THORACIC REGIONS, &c.

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ON AUSCULTATION.

Regions.	No.	Situation.	Interior corresponding parts.	Natural sound on percussion.	Signs commonly produced there by disease.
1. Clavicular. (Subclavian of LAENNEC.)	2.	Clavicles.	Apices of the lungs.	Very clear towards the sternum; clear in the middle; dull close to the humerus.	Dulness on percussion in phthisis; generally most on one side.
2. Infra-clavicular (anterior superior of LAENNEC.)	2.	Between clavicles and 4th ribs.	Superior lobes of lungs; large bronchi near the sternum.	Very clear.	Irregular dulness on percussion, diffuse bronchophony, impaired respiration, and afterwards cavernous rale, respiration, and pectoriloquy, in phthisis. Various rales in catarrhs.
3. Mammary.	2.	Between 4th and 8th ribs.	Middle lobes of the lungs; large bronchi in upper part near the sternum; heart generally covered by the lungs, in the lower part of left region.	Very clear, particularly by mediate percussion. In women a clear sound can be obtained through the mammae only by mediate percussion.	Rales in catarrh; more rarely phthisical symptoms; clear in pneumothorax. On left side dulness on percussion in pericarditis and enlargement of the heart; increased impulse in hypertrophy; and increased sound of pulsation in dilatation of the heart; sometimes extending to the right, with or without <i>bruit de soufflet</i> or <i>de rape</i> .
4. Infra-mammary.	2.	Between 8th ribs and the margin of cartilages of false ribs.	Liver on right, stomach on left side, covered only on upper part by the thin margin of the anterior inferior lobes of the lungs.	Dull on right side; on left, irregularly dull, or unnaturally resonant.	Crepitant rale in incipient pneumonia. Extinction of respiration, with dull sound on percussion, in advancing pleurisy.
5. Superior sternal.	1.	Upper part of sternum.	Large bronchi.	Very clear.	Bronchial rales in catarrh.
6. Middle sternal.	1.	Middle part of sternum.	Margins of middle parts of lungs.	Very clear.	Catarrhal rales.
7. Inferior sternal.	1.	Lower part of sternum and ensiform cartilage.	Above, margins of lungs; below, heart, liver, and sometimes the stomach.	In upper part clear; rather less so in fat persons. Below, sometimes more dull, sometimes tympanitic.	Dulness on percussion in pericarditis, accumulation of fat or serum in pericardium, hypertrophy, &c.



8. Axillary.	2.	In the axillæ, above 4th ribs.	Very clear.	Dulness on percussion, cavernous rale, pectoriloquy, &c. in phthisis. Catarrhal rales.
9. Lateral.	2.	Between 4th and 8th ribs, at the sides.	Very clear.	Dulness on percussion in advanced pleurisy, and on right side from enlarged liver. Ægophony in advancing pleurisy: crepitant rale and bronchophony in advancing pneumonia.
10. Inferior lateral.	2.	Below 8th ribs, at the sides.	The same as the inframammary.	Crepitant rale in incipient pneumonia. Extinction of respiration in pleurisy.
11. Acromial.	2.	Between clavicles and upper margin of scapulae.	Dull by direct percussion; tolerably clear by mediate percussion, particularly near clavicles.	Dulness on percussion in extensive tubercular accumulation; cavernous rale, respiration, and pectoriloquy in phthisis. Catarrhal rales.
12. Scapular.	2.	The scapulae and muscular ridge below them.	The pectoral resonance can be elicited from this region only by mediate percussion.	Catarrhal signs. Ægophony in pleurisy. Bronchophony in pneumonia.
13. Inter-scapular.	2.	Between the inner margin of the scapulae.	Pretty clear by mediate percussion, or when the arms are crossed and the head bowed forwards. The spinous processes of vertebrae sound well.	Catarrhal signs. In upper portion sound of respiration is never destroyed in effusions into the pleura: lower portion is sometimes the seat of ægophony in pleurisy, and of rale crepitant and bronchophony in advancing pneumonia.
14. Inferior dorsal.	2.	From inferior angle of scapulae and border of the serrati, below them to the level of 12th vertebra.	Clear in upper portion, by striking on the angles of the ribs, or by mediate percussion; below, often dull on right, and unnaturally resonant on left side.	Crepitant rale and bronchophony in incipient pneumonia; ægophony in pleurisy; and dulness on percussion in both.

CHAPTER III.

AUSCULTATION OF THE HEART'S ACTION IN HEALTH.

THE signs accompanying the action of the heart, generally speaking, are by no means so sure and satisfactory as those already described. It must be admitted, however, that much, which would otherwise remain hidden, is brought to light by the use of auscultation ; and, with regard to certain affections of the organs of circulation, auscultation may be regarded as affording a tolerably exact diagnosis.

Among writers who treat of the action of the heart in health, an unfortunate error has crept in, concerning the rhythm of the contraction of its different parts. This error was first made by LAENNEC, and has, since the publication of his work, until the appearance of Mr TURNER'S paper*, been recommitted by almost all who have written on the subject ; and, although Mr TURNER has shewn,

* Trans. Edin. Med. Chir. Soc., vol. iii.

that, previous to his time, indeed nearly a century ago, the rhythm of the heart's action was rightly understood, still it is to him that the medical world is indebted at present, for rescuing this important fact from the oblivion into which it was falling. It is only since the publication of his excellent paper, that the attention of medical men has been directed to the subject, and the otherwise excellent remarks thereon by LAENNEC have been questioned.

The importance of a correct knowledge of the action of the heart is obvious ; for it must be admitted, that the diseases of that, or indeed of any other organ, cannot be properly understood without a knowledge of its action in a state of health ; and, at the same time that we offer our tribute of praise to the labours of Mr TURNER, we congratulate the medical world on the knowledge of this re-established fact.

SECTION I.

ON THE IMPULSE AND SOUNDS OF THE HEART'S ACTION.

ON applying the ear or the stethoscope, to the region of the heart, we hear, for every beat of the arterial pulse, two distinct sounds, immediately following each other,

with an evident interval after the second of these. The first sound has been described by LAENNEC as "somewhat dull and prolonged, but distinct; the second as sharper, and analogous to that of a valve which is raised, the crack of a whip, or the lapping of a dog,"—comparisons which are very exact, and have never been questioned; for indeed the opportunity and talent for observation possessed by LAENNEC were so great as to render almost any description he has given, perfect, and certainly of great authority.

Aecompanying the first sound, or that immediately after the pause, there is an evident shock or impulse communicated through the parietes of the chest, and the stethoscope, to the ear. This is in general felt by the hand, but not always, and the strength of the impulse cannot so well be ascertained by this method. The impulse of the heart's action can, in general, only be perceived over the upper part of the left mammary region (3), and sometimes in the middle (6), and inferior sternal (7) regions; but, in cases where the thorax is very narrow, and the person thin, it can be perceived more extended than even this.

The sounds of the action of the heart are always perceived to be more diffused than the impulse, and, from personal experience, we have no hesitation in stating, that, in general, these can be heard almost all over the ante-

rior part of the left side of the chest, in the course of the sternum, and in a great many cases several inches to the right of it; but there is always one point, which is for the most part between the cartilages of the 5th, and 6th, or 7th ribs, where the sounds, as well as the impulse of the heart, are more distinctly heard. When the person examined stops his respiration, the sounds can be heard more diffused; and we may here remark, that the sounds of the heart's action, in many cases, will be much more distinct—and in some, in which the respiration is accompanied with loud rales, will only be heard—when the person examined stops his respiration; and this can, in general, be done for a short time with very little inconvenience: when it gives the slightest uneasiness, however, it must not be repeated.

Such is a sketch of the general state of the heart's action by auscultation; but nothing is more liable to varieties in intensity of action than this organ. The impulse and sounds are found to differ very much, according to the state of the individual. When the person examined is agitated, has been taking violent exercise, or is under the influence of any unusual stimulus, the impulse and sounds are, in general, rendered more distinctly and widely perceptible. The reverse takes place when the individual is quiet and abstemious; so that these circumstances sometimes render it difficult to say whether

disease be present or not. But frequent examination generally removes this difficulty.

After some little experience, it is as easy to distinguish an increase of impulse or sound, in the action of the heart, as it is to tell the state of the pulse; and it is by experience alone that this is attained. By the application of the stethoscope to the region of the heart, we always obtain a much better knowledge of the action of that organ, than by the application of the finger to the pulse; and to prove this, it is sufficient to say, that, in some cases, while the pulse at the wrist is very feeble, the action of the heart may be unusually strong. The sounds heard at the lower end of the sternum are believed to indicate the action of the right side of the heart; those heard between the cartilages of the ribs, of the left cavities. Such observations, however, it would appear are not much to be trusted, according to the present state of our knowledge on this subject. Our experience does not bear us out in upholding them.

SECTION II.

ON THE RHYTHM OR ORDER OF CONTRACTION OF THE
DIFFERENT PARTS OF THE HEART.

THE first sound, mentioned as dull and prolonged, but distinct, is—according to the opinion of LAENNEC, and all authors on the subject, with the exception of Drs BARRY and CORRIGAN, whose opinions we shall afterwards examine — that accompanying and caused by the contraction of the ventricles*. The next sound, however, which immediately succeeds to that, and already described as sharper, and somewhat like the lapping of a dog, is by no means so easily explained. LAENNEC states that it announces the contraction of the auricles; but this has been distinctly proved by Mr TURNER, in the paper already mentioned, not to be the case. The sound under consideration is found to succeed that of the contraction of the ventricles, without any interval. Now, Mr TURNER has shewn that the contraction of the auricles always takes place before that of the ventricles; and this, *a priori*, we should expect to be the case, for it is

* Some late experiments performed by Dr HORE seem to corroborate this. See Med. Gaz. 1830.

known that the presence of the blood in the ventricles is one great stimulus to their contraction, probably the most powerful. Besides, it is evident that if the contraction of the auricles took place last, or immediately before the interval of rest, the ventricles would remain distended with blood during that period,—a circumstance at least highly improbable. But Mr TURNER has given many facts in support of his arguments, and to these he has added the testimony of the following physiologists, viz. HARVEY, LANCISI, HALLER, SENAC, and MAGENDIE. Most of these authors distinctly state, that the contraction of the auricles precedes that of the ventricles; and all, that it certainly does not take place after. From personal observations on the heart's action in living animals, Mr TURNER states, that the contraction of the auricle appeared the first motion of the heart, and was followed so immediately by that of the ventricles, that he found it very difficult, if not impossible, to distinguish any interval between them. From examination of living animals, we are likewise inclined to be of the same opinion. The contraction of the auricles and ventricles, especially in small warm-blooded animals, seems to be one continuous movement, and the most accurate simile we can give of it is to liken it to the rolling of a wave, the motion proceeding from the auricles to the ventricles apparently uninterrupted in its progress; but we could,

in general, distinctly perceive the action to have its commencement in the auricles.

From analogy, then, we are entitled to infer, that the action of the human heart is the same, or that the contraction of the auricles precedes that of the ventricles.

But Mr TURNER has not allowed the subject to rest here ; he has drawn arguments from observations made on man. We shall quote his own words. He says, “ In the human subject, venous pulsation is frequently distinctly observable in the jugular and subclavian veins, in certain diseases of the heart, or of the lungs, in which the flow of blood through these organs is impeded ; but it can also be sometimes observed at the root of the neck, in individuals in whom there is no reason to suspect organic diseases of these organs, particularly in thin persons whose veins are large and lax. In such instances I have frequently examined the motions of the artery and vein very attentively, and have remarked first the pulsation of the vein, indicating the contraction of the auricle, immediately followed by the pulse in the artery, indicating the contraction in the ventricle, and then an interval marking the diastole of the heart, again followed by the successive pulsations, first in the vein, and then in the artery.”

From these observations, Mr TURNER justly concludes, that the contraction of the auricles takes place

before that of the ventricles, and after the interval of repose. And that such conclusions are correct can scarcely be doubted; for physiologists agree, that, during the contraction of the auricles, the blood expelled by their action is partly thrown back upon the veins, and in its reflux from the right auricle produces a pulse sometimes visible in the veins of thin persons; and, as observed by Mr TURNER, such is seen to be the case by examination of the lower animals. Now, though, in general, during health, venous pulsation is not manifested in the external veins of man, still we cannot doubt for a moment that, when it does take place, such a phenomenon is as exact an indication of the contraction of the auricles, the right at least, and we know both to be synchronous, as the pulsation of an artery is of the contraction of the ventricles, at least of the left, and we know these to be synchronous also.

In addition to the evidence which Mr TURNER has given on the subject, we shall notice a case which lately came under our observation, and which appears to corroborate his view of the rhythm of the heart. A woman aged sixty-six, had been for several years subject to severe cough, dyspnoea, and palpitation, especially during winter, and always increased on any unusual exertion. The impulse of the heart was not very strong, but more diffused than usual. The double sound of the heart's ac-

tion was likewise heard more diffused than natural, being perceptible over the left side of the chest, both anteriorly and posteriorly, accompanied with distinct *bruit de soufflet*, which was most distinctly heard between the 6th and 8th ribs. Pulse 40, when quiet, full and jarring; but instantly raised to 80, and less full, on the slightest exertion; for example, merely after turning herself in bed. The subelavian arteries pulsated strongly, and there was distinct, though not powerful, pulsation of the left jugular and subelavian veins, especially of the latter. The pulsation in the veins was observed to take place immediately before that of the subelavian artery, twice for once of the latter, when the pulse was 40, only once when the pulse was 80. After the pulsation of the artery, there seemed to be a short interval of rest, followed by the pulsation of the subelavian vein and jugular. The veins of the right side of the neck were distended, but without pulsation.

This, which was probably a case of catarrh, accompanied with emphysema of the lungs, and diseased heart, shews distinctly the rhythm of the heart's action; and indeed may be considered as a particularly fortunate one for the purpose; for, in consequence of the slow arterial pulsation, and the double venous pulsation, it was comparatively easy to make these observations.

It may perhaps be supposed that the arterial pulse did

not indicate the number of contractions of the ventricles, as is sometimes the case, but the application of the stethoscope proved that it did; and, indeed, when an artery of such magnitude and proximity to the heart as the subclavian is examined, its pulsations may be taken as an exact index of those of the heart itself.

To those who are doubtful on this subject, the examination of a single well marked case, such as the one described, will, we are satisfied, at once remove all scepticism. Dr CORRIGAN, in a paper lately published, comes to somewhat the same conclusions concerning the rhythm of the heart *.

SECTION III.

ON THE CAUSE OF THE FIRST SOUND HEARD DURING THE ACTION OF THE HEART.

ON this subject there are various opinions; but, before commencing an examination of these, we shall, believing it to be of importance in the consideration of the subject, first examine that doubtful point,—the cause of the dilatation of the ventricles of the heart.

Notwithstanding the ingenious arguments of Dr WIL-

* Trans. of King's and Queen's College of Physicians, Dublin, 1830.

LIAMS of Liverpool*, and others, we are inclined to coincide with the opinion of MAGENDIE, Dr WILSON PHILIP, and LAENNEC. We believe that the dilatation of the ventricles is not passive, and that it does not take place merely by a rush of blood into these cavities, from the auricles; nor is there reason to suppose that another set of fibres come into play, causing active dilatation: it appears more just to suppose, that all the muscular fibres of the ventricles, are, during that phenomenon, in a state of rest or relaxation; and that the dilatation takes place, as stated by MAGENDIE, in consequence of the elasticity of the organ, by which it regains its natural dimensions after the contraction, aided, however, and probably brought to that pitch of distention necessary to cause a sufficiently forcible contraction, by the contraction of the auricles. Such appears to us to be the most probable explanation, and for the following reasons:

1. If a heart be cut across midway between the base and apex, the ventricles will be found to remain open; their walls, more especially those of the left ventricle, keep apart from each other, forming nearly a circle, which, on being pressed together, immediately resumes its former state, on the pressure being withdrawn. There is another experiment which shews this well: if the point of the finger be inserted into the apex of the

* Edin. Med. and Surg. Journal.

left ventricle of the heart of a sheep, which it will be found completely to fill, and be then gently pulled out, an action very similar to the feeble contraction of the ventricle, will take place : in consequence of the adhesion of the surface of the finger, and inner surface of the ventricle, or in other words, the tendency to the formation of a vacuum, produced by the process of withdrawing the finger, the apex will become drawn up, and the organ contracted ; but, immediately when the finger separates from the walls of the cavity, dilatation takes place, and the ventricle becomes lengthened and enlarged every way.

2. The action of the heart when removed from the body, does not cease for some time afterwards, as is well known ; and if this action be attentively examined, evident contraction and enlargement of the organ will be observed.

The remark of PECHLIN, quoted by LAENNEC, is also to the point here : He says, “ That the dilatation of the hearts of vigorous animals, is sufficient to press open the compressing hand.” The fact of dilatation of the ventricles taking place, without the presence of blood, is strong testimony of the existence of some inherent power of dilatation, and this is probably owing to the elasticity of the walls of these cavities.

This power of elasticity is possessed in a much less degree by the right ventricle, and indeed does not seem to

be required so much by it. Admitting to a certain extent the effect of inspiration in propelling the blood, the following remarks may perhaps explain how the want of elastic power in the right ventricle is compensated for. Dr BARRY has shewn, that, during the act of inspiration, in consequence of there being a tendency to form a vacuum created in the chest, the blood in the external veins leading to the heart, is as it were sucked in towards the right auricle. We agree with Mr TURNER, however, when he says, that this cannot be the case with the blood in the pulmonary veins, as argued by Dr BARRY, for these "are within the thorax, and consequently exposed, equally with the heart itself, to the influence of any power, which has a tendency to remove the pressure of the atmosphere from the viscera contained in this cavity." Even admitting with Dr BARRY, that the tendency to form a vacuum in the pericardium may influence the motion of the blood in the pulmonary veins, still this must be very slight, when compared with that produced by the pressure of the air on the external veins; for the tendency to form a vacuum in the chest generally, will tend rather to retard the progress than otherwise, and this may probably overcome or counterbalance any effect of the tendency to the formation of a vacuum in the pericardium on these.

If what has just been stated, then, be a correct view

of the subject, it appears that the blood within the veins leading to the right auricle will be propelled towards this, at least to a certain extent, by the power mentioned; and it also appears that this will not happen with the blood in the pulmonary veins. In the right ventricle, where the circulation is aided by the influence of atmospheric pressure, the elasticity is very little; whereas in the left, where the influence of the atmosphere is removed, the elasticity is great; thus the loss of power in one way seems to be made up by means of another. In the former case, the blood flows towards the right auricle, the tendency to form a vacuum in the chest being produced during inspiration; and, in the latter, the blood flows towards the left ventricle, during the tendency to produce a vacuum by its own elasticity, at the moment of its diastole.

But, after all, the effect of inspiration can be very slight; and we must admit, with Mr TURNER, "that there are other powers quite independent of the removal of the pressure of the atmosphere from the surface of the heart, either by respiration or by its own contraction, which are sufficient to produce the motion of the blood through the heart and bloodvessels. This seems to be proved by the circulation of the blood in the fœtus in utero; and by the eases in which the surface of the heart has been exposed to the atmosphere, and its action and

the circulation of the blood have continued. We have examples of this kind in infants, in which the heart has been protruded to the outside of the thorax, through an aperture in that cavity, and in cases in which the cavities of the chest and pericardium have been opened by injury or disease."

"It appears also," continues he, "to be proved by experiments on animals, in which, after the muscles of respiration have been paralysed by poisons, or the cavities of the thorax have been laid open, the action of the heart and the circulation have been continued by maintaining artificial respiration; as well as by cases of asphyxia in the human subject, in which, the motion of the heart and of the blood has been restored by the inflation of the lungs through the trachea. In these experiments and cases it is obvious, that, instead of the pressure of the atmosphere being removed from the heart and lungs, an additional pressure is made on all the contents of the thorax during its expansion*".

From these remarks, it follows, that though the tendency to produce a vacuum in the chest may have a slight effect in moving the blood, still the action of the heart is able to be maintained independently of it, consequently there must be some other cause. The heart, as

* Med. Chir. Trans. vol. iii.

before stated, continues to act, even after it has been removed from the body, and many animals, low in the scale of being, do not possess the means of producing this tendency to a vacuum, ascribed to the higher animals.

Having considered the cause of the dilatation of the ventricles, especially of the left, which we believe to be their own elasticity, we shall now proceed with our subject.

It has already been stated, that LAENNEC, and most authors who have followed him, are of opinion that the first of the two sounds heard during the action of the heart, is caused by the contraction of the ventricles; and of this there can be little doubt, for the sound is synchronous with the impulse of the heart, which we have every reason to believe is caused by the tilting of this organ forwards and upwards, during its contraction, by which it is made to strike against the parietes of the thorax.

The peculiar views of Dr BARRY have led him to adopt another idea on this subject*. He believes that the contraction of any one of the cavities of the heart, causes instant dilatation of another, in consequence of a tendency to the production of a vacuum within the pericardium, aided by the respiration. He believes the space

* Recherches Experimentales, &c. 1825.

occupied by the heart to be always the same; that left by the contraction of the ventricles being instantly occupied by the distended auricles; and the space left by the contraction of the auricles being immediately occupied by the distended ventricles.

Under the influence of such a theory, Dr BARRY is inclined to attribute the sounds produced by the action of the heart, to the dilatation of its cavities. He says, "The two sounds which the heart presents by auscultation, are produced by a dilatation of these cavities, and not by their contraction. The first sound, which does not always correspond to the arterial pulsation, is the result of the expansion of the auricles, and the second of that of the ventricles."

The fact of the first sound not always corresponding to the arterial pulse, is no argument against its being that caused by the contraction of the ventricles, as we shall afterwards shew more fully; and, even according to Dr BARRY, the latter must take place at the time, for he says, the dilatation of the auricles, to which he rather attributes the first sound, takes place at the same time, and is in a measure caused by the contraction of the ventricles.

But, indeed, were we even to admit, for argument's sake, the influence of the tendency to the formation of a vacuum in the pericardium, produced by the contraction

of the auricles and ventricles, a statement, however, which seems to be without the slightest argument in its favour, still, it appears to us that such a tendency to a vacuum would be much more, or at least just as likely, to be followed up, by the collapsing of the pericardium, and the expansion of the light texture of the lungs, even admitting their resiliency, than by the auricles or ventricles. Besides, it is quite evident that there are other and far more important powers, which have their influence in the action of the heart; in proof of which it seems sufficient to mention, that the action of the heart and circulation of the blood can be maintained, when the pericardium and chest are laid open, artificial respiration being employed.

Mr TURNER has the following remarks on this subject. "With regard to the explanation of Dr BARRY, of the sounds emitted during the action of the heart, I cannot discover that it is justified by any of the facts stated in the experiments, or by the reasoning founded on them. The cause assigned for the second of the consecutive sounds appears to me liable to the same objection that I have stated to that supposed by LAENNEC; for the dilatation of the ventricles is synchronous with the contraction of the auricles; and I have endeavoured to shew that this last does not coincide with the second sound or succussion produced by the motion of the heart."

The passage just quoted contains a strong argument

against the opinion of Dr BARRY; and, from what has been stated in a former part of this paper, there appears to us to be no doubt of the correctness of the opinion offered by Mr TURNER on the rhythm of the heart's action.

Dr CORRIGAN, in the paper already alluded to, has advanced another explanation. He believes that the "impulse and first sound are caused by the rush of blood from the auricles into the dilating ventricles; not by the contraction of the ventricles as hitherto taught." He objects, and perhaps with propriety, to the explanation of the impulse of the heart given by HUNTER; and the following remarks of MAYO shew that he likewise is dissatisfied with it as the sole explanation. His words are: "At the moment when the ventricles act, the apex of the heart is thrown upwards against the side of the chest. Various solutions have been proposed of this phenomenon; of which the most ingenious attributes it to the extension of the curve of the aorta upon the rush of blood from the left ventricle. But it is questionable whether the cause supposed would produce the effect which it is employed to explain; and it is certain that, when its influence is wholly removed, the movement of the apex of the heart may take place as before. I ascertained, that if the heart of a dog recently killed, while yet palpitating, be placed upon a table, the apex con-

tinues to be lifted up at each contraction of the empty ventricles. In this instance, it is obvious that the movement of the apex of the heart must either depend upon the direct action of the exterior fibres of the ventricle, which tend, when the base of the heart is fixed (as on this occasion by its weight alone), to raise the apex; or be indirectly produced through the reaction of the surface, upon which the heart rests when contracting."

While the passage just quoted evidently shews that the explanation offered by HUNTER is inadequate, it at the same time points out, that some other than that of Dr CORRIGAN is required to account for the impulse of the heart. But we shall consider some of the arguments by which he supports his conclusions.

Concerning the rhythm of the pulsation of the heart against the side, and that of the arteries, he has the following remarks: "The arteries being always full, and fluids being nearly incompressible, it follows that an impulse from the ventricle must be felt in the arterial branches at the very instant of time of the contraction of the ventricle; that, therefore, the pulse indicates precisely the moment of that contraction. The arterial pulse, then, being exactly synchronous with the contraction of the ventricle, and the striking of the heart against the side being, according to all physiologists, a consequence of that contraction, it follows that the arterial pulse

should be felt a moment before the heart strikes the side ; or that, at the farthest, the impulse against the side and the pulse should be synchronous."

He then proposes to his reader the following simple experiment, namely, to "place the index finger of his right hand on the point where his own heart beats most strongly, at the same time keeping the thumb or fore-finger of the left upon the radial artery of his right hand. When his heart is beating slowly and forcibly, he will perceive distinctly that the first tap is against the ribs, the second from the pulse."

"The second tap," continues he, "indicates the precise moment of the contraction of the ventricle ; the first, the heart's impulse against the side : the contraction of the ventricle is consequently posterior to the impulse of the heart. An effect cannot precede its cause ; therefore the contraction of the ventricle which follows cannot produce the heart's impulse, which has gone before."

In analyzing the passage just given, we commence by admitting that the arteries are always full, and that fluids are nearly incompressible. But the arteries do not at all times contain the same quantity of blood ; and besides, they are possessed of elasticity. The arguments of Dr CORRIGAN only apply to rigid tubes, where the incompressibility of fluids would produce the effect he has mentioned ; but surely a fluid contained in an elastic

tube is under very different circumstances; and the elasticity of the containing tube is quite equivalent to manifest compressibility of the contained fluid, supposing that possible.

The fact of the dilatation of the arteries, from the contraction of the ventricle, has been long ago proved by physiologists; but this, Dr CORRIGAN seems to have entirely overlooked. His conclusion on this subject is to the following effect. He says, "It follows that an impulse from the ventricle must be felt in the arterial branches at the very instant of time of the contraction of the ventricle; that therefore, the pulse indicates precisely the moment of that contraction."

From what has already been stated, however, we cannot come to the same conclusion with Dr CORRIGAN. Instead of the impulse from the ventricle being perceived in the arterial branches at the very instant of time of its contraction, as it might be in rigid tubes, it appears to us more reasonable to suppose, taking the contractility of the arteries into account, that there would be a short interval between the contraction of the ventricle and the communication of its impulse to the arteries in a remote part of the body; and this we found corroborated by very simple experiments, which shall presently be noticed.

LAENNEC has mentioned the occasional non-synchronism of the beat of the heart, and pulsation of the radial

artery; and it has also been observed by Dr BARRY*. It is only distinctly perceptible in persons with a slow pulse. In those the action of whose hearts is rapid, no distinct interval can be perceived; and it is probably from this circumstance that the observation has not been more frequently made, medical men being so much more in the habit of examining rapid than slow pulses.

We are indebted to Dr CORRIGAN, however, for having pointed out more clearly than was done before, the occasional non-synchronism of the pulsation of the heart and arteries; and the experiment already quoted, in which he proposes to his reader to place the one hand on his heart, and the other on his radial artery, shews this tolerably well, when the pulse is slow, 60 for example; when much above this, however, it is difficult, if not impossible, to perceive the non-synchronism. A better experiment than that of Dr CORRIGAN, especially when examining others, is to place one hand on the region of the heart, the other on the posterior tibial artery at the inner ankle; the non-synchronism is more distinct in this experiment than in the former, the artery being more remote from the heart.

So far we quite agree with Dr CORRIGAN concerning this fact, but our conclusions are somewhat different

* Recherches Experimentales, &c.

from his, which we believe to be erroneous, and naturally flowing from the false data with which he sets out.

To proceed : “ The second tap,” continues he, “ indicates the precise moment of the contraction of the ventricle; the first the heart’s impulse against the side; the contraction of the ventricle is consequently posterior to the impulse of the heart.”

The erroneous nature of this passage we think will be rendered manifest by the following simple experiments : After examination of many patients, principally convalescents, in an extensive Hospital, and, having fixed upon those best suited to our purpose, we repeated the experiment mentioned by Dr CORRIGAN, and afterwards tried others of a similar nature, with the same result. Believing, however, that it was possible to explain the non-synchronism of the pulsation of the arteries, with that of the heart; and considering at the same time, the impulse of the latter, and the first sound, consequent upon the contraction of the ventricles, the following experiments were instituted :

1. One hand was applied to the region of the heart, and the other to the posterior tibial artery at the inner ankle. The two pulsations were perceived distinctly non-synchronous, that of the heart first, immediately after which that of the artery, then came the pause.

2. One hand being still retained on the posterior

tibial artery, the other was applied at one time to the carotid artery, at another to the subclavian, and still the non-synchronism of the two pulsations appeared to be much the same, or perhaps rather less than in the former experiment.

3. One hand being still retained on the posterior tibial artery, the other was transferred to the temporal. By this change the arteries were found to pulsate very closely upon each other, still it was evident that the pulsation of the temporal preceded that of the tibial artery.

4. One hand being placed on the region of the heart, and the other on the carotid or subclavian artery, the impulse of the heart and that of the artery appeared to be simultaneous.

5. The aorta and great vessels, down as far as the bifurcation of the popliteal artery, on one side, were dissected out the day after death. All the branches of these vessels were afterwards tied, except the two tibials, and several of the intercostals, which had been broken off. A short flexible tube was then attached to the arch of the aorta, and fitted to READ'S Syringe; with which water was thrown into the vessels by an assistant, while the following observations were made. One hand was applied to the commencement of the descending aorta, while the other was placed on the popliteal artery just before its division. During the action of the syringe,

the hands being thus applied, a distinct impulse was perceived both by the eye and fingers, but much more distinctly by the latter, at each jet of water thrown in. The impulse was perceived first by the fingers placed on the aorta, and immediately afterwards by those on the popliteal artery. The two impulses were distinctly non-synchronous, and this was fully more evident than in Experiment 3. The vessels were kept constantly full, the outlets for the fluid being few and small. The quantity of fluid thrown into the aorta by the syringe used, was about an ounce at each injection; the left ventricle is supposed to throw in only a little more than this at each contraction.

When the action of the syringe was rapid, the non-synchronism was with difficulty perceived.

From these experiments, then, we deem it fair to conclude, that the non-synchronism of the pulsation of the arteries of the extremities, with the impulse of the heart, is no proof that the latter is not caused by the contraction of the ventricle, as advanced by Dr CORRIGAN; moreover, they seem to afford strong evidence in favour of the impulse of heart, indicating "the precise moment of the contraction of the ventricle," which is the reverse of Dr CORRIGAN's conclusion.

Dr CORRIGAN attributes the impulse of the heart to the contraction of the auricles; being dependent on the

force with which these send their blood into the ventricles.”

On this we would remark, that, in consequence of the ventricles forming the principal part of the heart, it is evident that a considerable force of blood from the auricles would be necessary to raise the former, so as to produce the impulse. But, on looking to the anatomy of the auricles, we do not find them formed for such strong action. Besides, did such powerful action really exist, it is evident that it would be made manifest by constant and strong pulsation in the veins of the neck.

As additional evidence against the theory of Dr CORRIGAN, we would advance the case formerly mentioned, in which there was double pulsation of the auricle, and single pulsation of the ventricle. In that case, the first sound was perceived 40 times in a minute, so was the impulse of the heart; and this was likewise the case with the subclavian artery, and the pulse at the wrist. The fact of the heart and arteries coinciding in the number of pulsations in a minute, appears to us to be incontrovertible evidence in favour of the impulse of the heart being caused by the contraction of the ventricles. According to Dr CORRIGAN's theory, we should have had two impulses from the heart immediately following each other; and instead of two, three sounds; one corresponding to each contraction of the auricle, the other

the usual second sound, quick and short ; but it was not so* .

Believing then, that the first of the two sounds heard during the action of the heart is caused by the contraction of the ventricles, our next inquiry is concerning the immediate cause of the sound.

* It has been advanced, with great truth, against the theory of Dr CORRIGAN, that an increase of impulse is found to coexist with hypertrophy of the ventricles, not with that of the auricles.—*Med. Chir. Review*, 1830.

Dr HOPE has likewise objected to this theory, on different grounds, and we beg to refer those who wish for more information on the subject to his papers in the *London Medical Gazette* for July and August 1830.

In the *Journal Hebdomadaire de Medecine*, 3d April 1830, there is an account of a new analysis of the movements of the heart ; read to the *Academie Royale de Medecine*, on the 16th of March 1830, by M. PIGEAUX. That gentleman seems to have come to somewhat the same conclusions as Dr CORRIGAN on this subject ; none of his arguments, however, are given, what we have alluded to being a mere notice of his conclusions. His views of the immediate cause of the sounds of the action of the heart are somewhat similar to those given in this Essay, which, with the exception of a few additions and alterations, is, as presented to the *Harveian Medical Society of Edinburgh*, in December 1829. We have given those parts of the Essay on this subject, without the slightest alteration, that the views there set forth may be compared with these of M. PIGEAUX. This, we trust, will exonerate us from any charge of plagiarism.

The second part of M. PIGEAUX's paper was read to the *Academie Royale de Medecine* on the 20th of April 1830 ; and his conclusions may be found in the *Journal Hebdomadaire* for 24th April 1830.

LAENNEC makes no remark on the causes of the sounds in the healthy heart; and, indeed, Dr WILLIAMS appears to be the only one who has advanced any opinion on the matter*; and, after alluding to the sound caused by muscular contraction, discovered by Dr WOLLASTON, he says, that it occurs in the contraction of the heart, and constitutes the sound of pulsation, which is heard in the præcordial region†.

We cannot, however, agree with Dr WILLIAMS on this point; not that we imagine that no sound is produced by the muscular contraction of the heart, but there is no evidence that this is loud enough to be heard by means of auscultation, or at least so as entirely to produce the sounds which we hear. Again, the sound of muscular contraction ought to be greatest when the number of the muscular fibres is greatest; but we know this not to be the case in reference to the heart; for it is found, that in hypertrophy, or thickening of the walls of this organ, the sound is rendered feeble, and in proportion to the thickening; while the impulse at the same time is much increased, shewing that there is strong action. In such cases it is evident that there is an increase of muscular structure, consequently the sounds depending upon the

* Since this was written Dr CORRIGAN, M. PIGEAUX, and Dr HOPE, have advanced opinions on the subject.

† Rational Exposition.

contraction of these ought to be increased ; and so, in all probability, they may be, but still it would appear that even then they do not become audible by auscultation ; for, instead of the sound of the heart's action being increased, it is actually diminished ; while at the same time we know that there is powerful action of the organ, from the tenor of its impulse.

Dr WILLIAMS further states, that the second sound of the heart's action is produced in the same manner ; but it does not appear that this sound is dependent upon muscular contraction at all, even as its remote cause ; indeed, it very probably is not.

Analogous sounds heard in arteries certainly cannot be accounted for by the theory of Dr WILLIAMS ; and we believe that an explanation of the cause of the two sounds will be much more easily found in the motion of the blood upon the walls of the heart. The motion of fluids upon solids is productive of sound : and we have made some observations which seem to prove this. We applied the ear in the neighbourhood of a small leaden pipe, leading perpendicularly from the bottom of a cistern of water ; and the moment that the stop-cock was turned, so as to allow the water to escape, we heard a distinct whizzing or rushing noise in the tube, and at every part of it. The intensity of the noise was likewise exactly in proportion to the extent to which the

stop-cock was turned; when this was to the full extent, the noise was much stronger than when only half turned, or to a less extent. By alternately opening and shutting the stop-cock, a sound very similar to the rasping sound heard in some cases of disease of the heart was produced. Sound, then, is produced by the motion of fluids upon solids, and it appears to us, that that heard accompanying the contraction of the ventricles is most probably caused by the same means, namely, by the motion of the blood on the walls of these cavities, during its expulsion from them*.

We have already stated, that the sound of the action of the heart is more evident, as the walls of the ventricles become thin; and less so when these become thick; the sound being, in the former case, probably more distinctly heard, in consequence of the intervention of a thinner layer of muscular structure, between the surface where the sound is produced, and the ear of the auscultator; as, in the latter case, a thick layer of muscular structure is interposed, rendering the sound feeble, or altogether inaudible†. The diameter of the tube, in which the sound described, was heard, might be somewhat less than

* Sound is produced by the motion of water in the aorta, by being injected into it after removal from the body.

† Besides, the ventricles contain more blood in the one case than the other.

half an inch, which is much less than that of the ventricles of the heart, so that the rasping nature of the sound, heard during the motion of the water in the tube, when compared with the dulness of that heard during the motion of the blood from the heart, may be accounted for, perhaps, by the nature of the walls, and the fluid in motion on them; and we shall afterwards find, that a somewhat similar sound to that described, is frequently heard in cases of disease of the aorta, probably depending upon the roughness produced on its internal surface; and sometimes likewise in cases of disease of the valves.

In some cases, sound may be produced by the rapid motion of the blood on the surface of the aorta, while in its natural state; in the same way as we observed an increase of sound to be produced by turning the stop-cock to its full extent, whereby a more rapid motion of the contained fluid was produced, and at the same time a greater quantity was allowed to pass through. This seems to explain the reason why the sound termed the *bruit de soufflet*, or bellows-sound, heard so frequently in cases of disease of the heart and arteries, and occasionally during violent action of the heart, from nervous agitation, &c., but entirely without the presence of organic disease, should be intermittent. But it is easy to conceive a diseased state of the valves of the heart, or inner surface of the bloodvessels, to be present, without any

unusual sound, provided the blood does not pass with that rapidity, or in that quantity, proper for its development. It also seems equally reasonable to conceive the occurrence of an increase of sound to take place in a healthy state of the heart, provided the blood flows through it in that quantity and with that rapidity necessary for the development of the sound.

From what has been said, then, we are of opinion that the sounds heard during the contraction of the ventricles in health and in disease, are all modifications of each other, and produced by the same cause, namely, by the motion of the blood upon the internal surface of the circulatory apparatus.

SECTION IV.

ON THE CAUSE OF THE SECOND SOUND PRODUCED BY THE ACTION OF THE HEART.

ON this subject there is much difference of opinion. LAENNEC, as formerly stated, believed the second sound to be owing to the contraction of the auricles; but this, as shewn by Mr TURNER, cannot be the case, for the contraction of the auricles does not take place synchronously with the second sound. Mr TURNER believes,

and we are inclined to agree with him, that the contraction of the auricles is perceived to be continuous with the contraction of the ventricles, and that the two contractions communicate only one sensation.

In explanation of the cause of the second sound, Mr TURNER says, "Can it be accounted for by the impulse occasioned by the falling back on the pericardium of the relaxed heart in its diastole, after it has been elevated or moved from its place in the systole?" and again, he says, alluding to the elasticity of the heart, "On this supposition has been founded the hypothesis, that the motion of the blood depends in part on the ventricles of the heart attracting this fluid by suction into their cavities from the corresponding auricles."

"This hypothesis," continues he, "does not seem improbable; and such an action, if it really occur, may perhaps contribute, in addition to the falling back of the heart, to produce the sensation communicated to the ear or the hand, which I am endeavouring to explain."

With regard to Mr TURNER's first explanation, we agree with Dr WILLIAMS of Liverpool *, that it is by no means satisfactory; and, without seeking for other arguments, we think that that advanced by Dr WILLIAMS is sufficient to prove its incorrectness. He says, "How can it be supposed that a sound produced by the falling

* Edin. Med. and Surg. Journ. 1830.

back of the heart on the pericardium, can be modified by a morbid lesion of the auriculo-ventricular valves." As an additional argument against this explanation, we may add, that we have observed the second sound distinctly in cases where there was universal adhesion of the pericardium to the heart.

We are much inclined, however, to support Mr TURNER'S second explanation, notwithstanding the objections of Dr WILLIAMS, founded upon his disbelief of the dilatation of the heart by its own elasticity; a subject which we have already considered, and on which we have come to an opposite conclusion.

We shall next examine Dr WILLIAMS' views. He believes the sound under consideration, to be caused by the flapping of the mitral and tricuspid valves against the walls of the ventricles, immediately after the systole of the heart, in consequence of the contraction of the columnæ carneæ, which he believes to take place synchronously with the dilatation of the ventricles; the columnæ carneæ, according to his views, being lengthened during the contraction of the ventricle, so as to admit of the closing of the valves.

Now, we cannot agree with Dr WILLIAMS on this point; nor can we see how the facts of the case accord with such an explanation. In the first place, there is no reason to suppose that the columnæ carneæ become

lengthened during the contraction of the ventricles, or that they act separately from the other fibres of the heart: on the contrary, from the latest observations of anatonists, these appear to be merely continuations of the external fibres of the heart, which we are sure contract during the systole of the ventricles, consequently there is every reason to suppose, that the columnæ also contract at the same time. The contraction of the muscular pillars of the valves—which are the only parts of the columnæ of importance in this question—in consequence of these being much shorter than the external fibres, will be much less than that of the latter, and probably not sufficient to neutralize the effect prodneed by them, which is in part that of drawing the heart in a mass towards its base. The pillars of the valves, then, forming a part of the general mass, will, during the contraction of the external and other fibres, be approximated to the base of the organ. By their own contraction, however, they will at the same time be drawn in an opposite direction; but as their contraction, compared with that of the more external fibres, will be much less, so, after all, the pillars of the valves may be actually brought nearer to the base of the heart; not lengthened, according to Dr WILLIAMS, but really shortened, and in a state of contraction, necessary for preventing the valves from being pushed into the annicles, during the contraction of the ventricles.

The action of the columnæ carneæ appears to be much more satisfactorily explained in this way, than by supposing separate action of these parts; and it would appear that Dr WILLIAMS has overlooked the general effect of the contraction of the ventricles, when he says, that the valves cannot close the auriculo-ventricular openings, without the columnæ carneæ being extended. We have endeavoured to shew that these may really be contracted, and at the same time admit of the pillars of the valves being brought nearer to the base of the heart.

If this view of the subject be correct, then it follows, that the sound under consideration cannot be produced by the flapping of the valves against the sides of the ventricles, caused by the supposed contraction of the columnæ carneæ, after the systole of the heart. But we object to the explanation of Dr WILLIAMS, on other grounds.

The idea is purely hypothetical; and, even admitting the contraction of the columnæ carneæ, according to Dr WILLIAMS' views, still we cannot conceive it possible that any flapping of the valves against the walls of the ventricles could take place, because of the blood which probably remains in the ventricles after each contraction, and the dilatation of these cavities at the same time; and, indeed, Dr WILLIAMS states, as one of his reasons for supposing the closing of the semilunar valves, to

have little to do in causing the sound in question, that their motion must be somewhat moderated by the pressure of the unexpelled blood yet remaining in the ventricle. Now, it appears to us that the motion of the mitral and tricuspid valves must be acted upon in a similar way, by the blood remaining in the ventricles. But, even supposing that these valves did strike against the walls of the ventricles, we cannot imagine a sound so sonorous to be produced in this way; we know of nothing analogous.

Dr WILLIAMS, as already mentioned, is of opinion, that the columnæ carneæ, by their contraction, open the valves. The reverse, and more correct, is the opinion of most physiologists, namely, that they, by their contraction, close the valves. We are not sure, however, that this is quite the correct explanation, when the structure of the pillars of the valves is taken into account. Each pillar is found to divide generally into two diverging papillæ; by the contraction of which these will be brought closer to each other, being united at the base, and the contraction taking place, in a line from the apex to the base of junction; consequently, the valves, through the medium of the cordæ tendineæ, will be approximated; but it does not appear that by this they will be entirely closed; for the columnar extremities of the cordæ tendineæ cannot be brought close to each other, in consequence

of the lateral rounded projection of the pillars of the valves themselves, from which it is probable that these valves never can be completely closed by this cause; and we believe that the pressure of the blood, which acts alone upon the sigmoid valves, also performs a similar function to a certain extent, in the closing of the mitral and tricuspid valves; and the comparatively loose and floating edges of these valves, between the attachments of the cordæ, may be the parts principally acted upon*.

We would rather attribute the sound under consideration to the rushing of the blood into the ventricles, during the elastic dilatation of these. As before stated, Mr TURNER gives it as his opinion, that this might contribute, along with the falling back of the heart on the pericardium; but we are inclined to go farther than Mr TURNER, and to attribute the production of the sound entirely to this cause†.

* Consequent upon our conclusions respecting the action of the heart, mentioned in a former part of this Essay, we cannot admit the theory of Dr CORRIGAN, proposed to account for the second sound of that organ. This sound he believes to be caused "by the striking together of the internal surfaces of the ventricle." If the conclusions alluded to be correct, independently of other arguments which might be brought against it, this theory of course must fall to the ground.

† Dr HORE has lately come to somewhat the same conclusions on this topic, and has proved that the second sound is synchronous with the ventricular diastole. See *Med. Gaz.* August 1830.

It has already been shewn, that there is great probability of the ventricles of the heart possessing a power of dilatation by their own elasticity; consequently, to fill up the tendency to a vacuum, produced by this, the blood may be, as it were, sucked into the ventricles from the auricles, during their dilatation, by a sudden motion. The nature of the sound seems to agree with this supposition; and the alteration of sound during disease of the auriculo-ventricular openings, is easily accounted for; while it cannot be so, on the supposition that the sound is caused by the flapping of the valves against the walls of the ventricles, at least in a great many cases; for the disease, which very frequently produces an alteration of sound, namely, the presence of fibrinous vegetations, frequently takes place on the auricular surface of these valves alone, which could not, we think, hinder the flapping of the valves against the walls of the ventricles, supposing this to take place during their healthy action.

What we have said concerning the production of the first of the two sounds, applies to a certain extent here; and it is easy to explain the existence of the *bruit de soufflet*, occurring as the second sound, without the presence of organic disease, in cases where the action of the heart is very energetic, or when a greater quantity of blood than usual is present in its cavities.

We have now given the sketch we intended of the va-

rious opinions on the causes of the sounds heard during the action of the heart, and stated what we believe to be the most plausible explanation, in the present state of our knowledge on this topic; but we cannot leave the subject without expressing our regret, that, after all that has been written, it still remains a kind of problem. What we have said has consisted more in the examination of the opinions of others, than in forming one of our own; but we trust that the few observations which have been made, will tend to throw some light upon this difficult and obscure subject*.

* It may be mentioned here, that the remarks on the cause of the sounds of the heart in health, as well as the following on the auscultation of the heart in disease, and that of the arteries, both in health and in disease, contained in Chapter III, from page 106, to the end of Chapter V, are, with the exception of the notes, exactly as presented to the Harveian Medical Society.

CHAPTER IV.

AUSCULTATION OF THE HEART IN DISEASE.

WE cannot commence this topic better, than by observing, that no conclusion as to the state of the heart can be drawn from any examination, unless this be made while the patient is in a state of quietude, both of mind and body. LAENNEC has insisted much upon this, and indeed the slightest reflection on the subject will shew the utility, nay the absolute necessity, of attending to such a precaution. In fact, no examination made without attention to this can be trusted.

SECTION I.

SOUNDS OF THE HEART'S ACTION IN A STATE OF DISEASE.

THESE may become more or less extensively heard: may be increased or diminished in intensity, or entirely altered in character. As we have already mentioned the

usual extent of the sounds of the heart in health, it is unnecessary to repeat them here.

On this subject, LAENNEC has the following remarks :
“ When the pulsations of the heart become more extended than usual, they are heard successively in the following places : 1. The whole left side of the chest, from the axilla to the stomach ; 2. The right side over the same extent ; 3. The posterior part of the left side of the chest ; and, 4. The posterior part of the right side. This last is rare. In these cases,” he adds, “ the intensity of the sound is progressively less in the succession mentioned ; for instance, it is less under the right clavicle than under the left ; it is somewhat less on the lateral parts of the left side than under the clavicle ; it is still less perceptible on the right side laterally ; and much attention is requisite to enable us to hear the pulsation at all on the back, particularly the right side. This succession,” continues he, “ has appeared to be constant, and may be taken as an index of the extent of pulsation. For instance, if this be perceptible on the right side, we may be assured that it will be equally so over the whole sternum, under both clavicles, and over the left side ; but we are not sure that it will be so on the back. But if it be perceptible on the back on the right side, we may calculate on its being still more audible on every other part of the chest.”

Such is LAENNEC'S excellent account of extended pulsation, with which our experience entirely agrees.

In the consideration of the sound of the voice, we mentioned that this was always better transmitted as the lungs were condensed. The same thing holds with regard to the heart, the sounds of the action of that organ being more extensively heard when this is the case; and it may serve as an additional indication perhaps of such a condensation. As formerly noticed, the pulsations of the heart may be more extensively heard, although the organ be quite sound, in very thin or narrow chested persons, and in children.

An increase of the sound, and it, as well as the impulse of the heart, being more extensively perceived than usual, indicate pretty correctly the dilatation of one or both ventricles; and this, we think, is going as far as we are at present entitled to do. However, it has been attempted to distinguish by the stethoscopic signs the state of each ventricle separately; but such observations appear as yet little to be trusted. The more diffused the sounds and impulse are, the greater the dilatation is indicated, these coinciding with each other.

The sounds of the heart's action may be diminished in intensity, and in the extent over which they are in general perceptible; so that, instead of being heard in the usual situation, they are sometimes only audible in a much more

confined space; this varying according to the amount of the disease, and other circumstances to be mentioned.

The diminution of the intensity of the sound, which is at the same time much prolonged, and of the extent over which it is heard, with increased impulse, is, as shall afterwards be noticed more fully, an indication of a thickening of the walls of the ventricles of the heart. If this occur, however, with a weak impulse at the same time, it is believed to be a sign of softening of the walls of the ventricles.

The sound of the heart's action may be slightly diminished, both in intensity and extent, by the intervention of a considerable portion of lung, or air, between the heart and parietes of the chest, as in pneumothorax, &c.

The sounds of the heart's action may become changed, and assume the character of what has been termed the *bruit de soufflet*, or the bellows-sound, from its resemblance to the noise produced by this instrument, when used to blow a fire; or the *bruit de râpe*, or sound of a saw or rasp, when used.

The *bruit de soufflet* is very exactly described by its name; it varies much in degree, and consequently is heard more or less diffused over the chest. It occurs most generally in cases of organic diseases of the heart; but is occasionally present when the heart is quite sound, during unusual action of this organ.

LAENNEC, in the first edition of his work on the diseases of the chest, considered this sound as a sign of the contraction of the orifices of the heart; and, in his second, after alluding to this, he says, "No doubt it exists almost always in this case, but since the first publication of my treatise, I have frequently met with it in individuals who had no lesion of the sort; while, on the other hand, I have seen ossification of the valves which were not attended by this sound. I have likewise frequently observed it in the last agony, and in other circumstances, when the heart is too full of blood; in which latter case it sometimes quickly yielded to bloodletting." And again, he says, "I can state with certainty, that the bellows-sound of the heart is very often met with when this organ is perfectly healthy."

LAENNEC believes that this sound is attributable to a sort of spasm or tension of the heart or arteries, or else to a particular condition of the blood itself, or to the manner in which it is moved. This last supposition, however, he adds, alluding to the occurrence of the bellows-sound in the arteries, "is inadmissible, inasmuch as the phenomenon exists sometimes in one artery only."

In reference to LAENNEC's first proposition, we think with Dr HOPE, that "imputing the phenomenon to so vague and mysterious a cause as spasm, is a premature

surrender to the difficulty *; for it appears to us, that this sound can be much better explained by a consideration of the movement of the blood. This is the opinion of BERTIN, who believes it to be owing to the increased friction of this fluid passing through the contracted orifices of the heart †. Dr WILLIAMS, on this topic, says, “He is disposed to think, that were we better acquainted with the laws of the production of sound, we might find that it may be excited by the motion of fluids, as well as that of air, in or against solids of a particular form; and that we might find a more satisfactory explanation of the phenomena in question, in the moving mass of blood being thrown into sonorous vibration, by some modification in its course. Such a modification might be produced by thickening or irregularity in one of the valves of the heart, or by spasmodic action of some of the columnæ carneæ, by an obstacle in the caliber of an artery, &c.; and these causes might, as in the analogous case of air, render the passage of the blood sonorous, instead of, as it usually is, silent ‡.”

* London Medical Gazette, 1829. † Mal. du Cœur, &c. 1824.

‡ Rational Exposition. This passage shews that Dr WILLIAMS was one of the first who suggested the cause of the *bruit de soufflet* in cases of disease of the heart or arteries. His remarks, however, only apply to the production of sound in these parts, in a state of disease; having quite a different view of the cause of the sounds in health, as already noticed.

LAENNEC, as formerly mentioned, is of opinion, that the sound termed the *bruit de soufflet*, is caused by spasmodic muscular contraction of the heart or arteries; but our objections to this, as an explanation of the healthy sounds, equally apply here.

We have already stated, that we believe all the sounds heard during the action of the heart in health and in disease, to be owing to the same cause, namely, the motion of the blood over the surfaces of the heart and arteries, these being modified in intensity, or altogether changed in character, by the nature of the surface over which the blood has to pass, or to the quantity or rapidity with which it does so.

LAENNEC, in the passage lately quoted, says, that the *bruit de soufflet* exists almost always in cases of contraction of the orifices of the heart; but states, that he has “seen ossifications of the valves which were not attended by this sound;” and adds, that he has “likewise frequently observed it in the last agony, and in other circumstances, when the heart is too full of blood, in which latter case it sometimes quickly yielded to bloodletting.”

We have again noticed this passage, because the latter part of it appears to shew a very satisfactory reason why the bellows-sound may depend upon the quantity of the blood present for its development; and, in the passage quoted, it is distinctly stated, that it yielded to

bloodletting, this fluid being probably present in too great a quantity.

In general, when there is disease of the valves to a considerable extent, we believe that this sound will always be rendered evident by slight acceleration of the circulation; whereby some of the circumstances necessary for its production will be developed.

LAENNEC further says, that it cannot be produced by the manner in which the blood is moved, "inasmuch as the phenomenon exists sometimes in one artery only." Now, we see nothing very difficult to explain here, for we know that there is sometimes an affection of one artery, or indeed of a part alone, at least to a greater extent than elsewhere, so as to present the necessary circumstances for the development of this sound, namely, want of elasticity in the vessel or part, with a rough internal surface; but here, as in the case of disease of the valves, if the quantity and rapidity of the motion of the blood be absent, we can easily imagine the presence of disease, without such an indication.

LAENNEC mentions the following curious case, which seems to illustrate this: "A man debilitated by syphilis, had no thrill or bellows-sound in the heart or arteries, when lying down or sitting up in the usual manner; but if he raised himself in bed, supporting himself on his elbow, a slight but very distinct purring thrill, and also

bellows-sound, became perceptible, over the extent of an inch square, a little above the right clavicle, and both these disappeared, upon the patient assuming the sitting posture*." The case quoted shews the variableness of this sound as a sign of disease. In this instance we would attribute the sound to the muscular contraction necessarily exerted by the comparatively constrained position, compressing the arteries in the arm unusually, whence the blood would be propelled through narrower channels, developing in part the circumstances necessary for the production of the sound; in this case perhaps in the right subclavian artery, which agrees with the probability of the patient having supported himself on his right elbow, but this is not mentioned.

The *bruit de râpe*, which is very similar to that implied by its name, is an increased degree of the *bruit de soufflet*; and, indeed, between these, various degrees are to be found: it occurs in similar cases, and indicates similar affections, but in general more aggravated. Both sounds most usually occur in cases of disease of the valves, whereby the orifices of the heart have become contracted, and this is especially the case, when the sounds are well marked, constant, and do not yield to bloodletting.

The *bruit de soufflet*, which occasionally forms the second sound of the heart, formerly termed the auricu-

* Mediate Auscult.

lar, is said to be an indication of disease of the mitral or tricuspid valves. But there is at present no certainty in this.

Our experience agrees with the remark just made, that the sounds under consideration most usually coexist with, and depend upon, disease of the valves of the heart, or their appendages. While, however, we state this, we must also admit with others, that disease of these may be present without such an indication, and, on the contrary, such an indication may be present without any disease; but these cases are comparatively rare.

The *bruit de soufflet* and *bruit de râpe* are most usually heard during the contraction of the ventricles,—we might say, in most cases, of the left ventricle; and when authors say, that they also occur during the contraction of the auricles, they mean, that the second sound is sometimes converted into one or other of these; but it has already been shewn that the second sound is not caused by the contraction of the auricles, but probably by the elastic dilatation of the ventricles alone.

In all cases where these sounds are heard, we believe that they are produced by one general cause, namely, by the motion of the blood upon the parietes of the heart during its expulsion or entrance, which, instead of flowing in the usual manner, eliciting merely those sounds heard during a healthy state of the organ, causes an increase

or alteration of sound, varying according to the nature of the lesion. The most usual morbid alterations which appear to be the cause of these sounds are the following, viz. osseous or cartilaginous deposition in the valves, whereby the entrance and exit of the blood is impeded, just in a manner similar to the change which takes place in the sound of respiration, when any impediment is in the way, such as mucus or other substances; and we know that the sound of respiration is occasionally very feebly heard, though the lungs be in a state of perfect health, but is immediately rendered quite distinct by a sudden inspiration; the increase of sound doubtless depending upon the increased quantity of air, and the rapidity of its motion along the air-tubes and cells. So it is with the action of the heart. The usual sounds heard during health take place, we shall suppose, in consequence of a certain proportion of blood being present in the cavities of this organ, compared with its contractile power. Now, should any thing occur to increase violently the action of the heart; should the quantity of blood be unusually great in its cavities, or any impediment to its progress be present, it is evident that this fluid will necessarily be moved in greater quantity, or with greater rapidity, supposing the same number of contractions to take place in a given time; or, should the number of pulsations decrease, it is not unreasonable to suppose that the action

of the heart, in such circumstances, will be very laboured, and require a power so great as probably, during the contraction, to produce the sounds in question, by the increased and energetic rush of blood from its cavities.

It appears that the bellows-sound may exist when the auriculo-ventricular valves do not accurately close these openings, either in consequence of being too small—or being perforated—or from the presence of fibrinous vegetation—or disease of the columnæ carneæ; and probably caused, in the former, by the rushing of the blood back into the auricles during the contraction of the ventricles; in the latter, by the diseased parts acting as foreign bodies, projecting from the floor of the ventricles. These are the most likely causes, as such sounds are generally the first of the two, and synchronous with the pulsation of the heart.

All that we are entitled to infer, in the present state of our knowledge, from the existence of these sounds, appears to be, that either there is disease of the valves of the heart, or their appendages—or of the inner surface of the ventricles—or that the other circumstances already mentioned are present, whereby the blood is moved through the cavities of the heart more profusely, and with greater rapidity or energy than usual.

SECTION II.

ON THE IMPULSE OF THE HEART AS AN INDICATION OF
DISEASE.

THE impulse may be perceived more extensively than the usual limits which have already been mentioned ; or it may be confined within narrower bounds. Again, the strength of the impulse may be increased or diminished.

When more extensively perceived, it generally indicates an enlargement of the heart, chiefly from dilatation of its cavities, and thinning of their walls. When perceived less extended than usual, it for the most part indicates thickening or induration of the walls of the ventricles of the heart ; and, in some cases, a diminution of the size of the organ.

When the strength of the impulse is increased, it denotes hypertrophy, or thickening of the walls of the ventricles of the heart ; but when the strength of the impulse is diminished, it indicates a thinning of the walls of the ventricles ; and, in some rare cases, softening of these.

The different circumstances mentioned concerning the impulse may be present separately, or in combination. When the impulse is at the same time more extended, and stronger than natural, dilatation of the ventricles

with hypertrophy of their walls are indicated. But when the impulse is less extended, and feebler, it denotes softening of the substance of the heart, or a diminution of the size of the organ.

There are various degrees of these affections; and the indications mentioned will be more or less marked, according to the amount of the disease.

The impulse of the heart is generally perceived more extended when fluid is present in the pericardium.

With regard to the contraction of the auricles, it does not appear that any sound is heard during their contraction, even in a state of disease, and but a feeble impulse is perceived; for, all that has been written on this subject must necessarily be erroneous, if the explanation noticed in a former part of this paper be the correct one. Therefore, until further observation, we refrain from saying any thing concerning these parts.

SECTION III.

ON THE IRREGULARITIES OF THE HEART'S ACTION.

THESE are numerous, and occur frequently; for the most part accompanying some organic alteration of the organ. The sounds heard during the action of the heart

may be unequally loud and long, when compared with one another. The impulse may be greater during one contraction than during another. The interval between the different pulsations may be changed—lengthened—shortened—or irregular; and all these are much better known by the use of the stethoscope than otherwise, for the pulse, especially that of the arteries of the extremities, does not always participate distinctly in the altered action.

With regard to the changes of the second sound, LAENNEC says, “It sometimes, though very rarely, happens during palpitation, that each contraction of the ventricles is followed by several successive contractions of the AURICLES, so quick as only to equal in point of time one ordinary contraction. In this sort of palpitation, I have sometimes reckoned two pulsations of the auricles for one of the ventricles; sometimes four, but most commonly three*.” What has been here termed the sound of the auricular contraction, must be understood to mean the second of the consecutive sounds. But we shall not attempt, in the present state of our knowledge, to explain the cause of such an occurrence as that just described. However, we cannot agree with the notion of LAENNEC; but how the dilatation of the ventricles, supposing this

* Med. Auscult.

to be the cause of the second sound, could produce such an anomaly, we are at a loss to determine.

Before leaving this subject, we think it may be advantageous to quote LAENNEC'S account of a healthy heart, as a standard of comparison. He says: "The heart, including the auricles, ought to be of a size equal to the closed hand of the subject, or only a little less or greater than it. The walls of the left ventricle ought to be of a thickness somewhat more than double that of the right. The texture of the left ventricle, firmer and more compact than that of the muscles, ought to keep it from collapsing when laid open. The right ventricle ought to be a little larger than the left, with columnæ carneæ of greater size, and ought to collapse on being cut into."

SECTION IV.

DISPLACEMENT OF THE HEART.

THE heart is occasionally found to occupy an unusual position in the thorax. This displacement is sometimes congenital; sometimes, and most frequently, produced by disease, as in empyema, pneumothorax, &c.; and depends for the most part upon an effusion to a considerable extent into the left pleura. The effusion may either

be solid, liquid, or aëriform. The displacement is caused by the mechanical pressure exerted upon the lung and pericardium, with its contents. When there is effusion, equally on both sides, however, no displacement can take place. Tumors are sometimes a cause of displacement of the heart. The position of this organ is much more easily determined by auscultation than by any other means.

Pericarditis.

We do not know of any stethoscopic sign whereby a diagnosis of this disease can be made out; but this has been attempted by M. COLLIN. He believes that a sound analogous to the “ crackling of new leather on being bent” is present in this disease, and diagnostic of it *. His observations, however, have not been corroborated. Tumultuous and strong action of the heart is common in that disease, with diffused impulse, when there is fluid in the pericardium.

* Des Diverses Méthodes d'exploration de la Poitrine, &c. Paris, 1824.

CHAPTER V.

AUSCULTATION OF THE ARTERIES IN HEALTH AND
IN DISEASE.

ON applying the stethoscope lightly to any of the great arteries lying near a bone, so that the vessel shall be between the extremity of the instrument and the bone, we perceive a slight impulse, corresponding to the beat of the artery; in general, when in a healthy state, accompanied with very little, if any, sound. But sound, as mentioned by LAENNEC, can be elicited to any degree by the simple experiment of compressing the vessel more or less with the extremity of the instrument. A sound resembling, only more hoarse and abrupt than, the *bruit de soufflet*, may be produced in this way. Such an experiment is best made on the femoral artery, just as it makes its exit from the pelvis, and sufficiently shews how any thing that diminishes the caliber of these vessels, or alters the state of their membranes, either by irregularity, the consequence of a deposition of lymph, cartilaginous or calcareous matters—by diminished dilatability—or by

an increased flow of blood through these vessels, while of their natural caliber, may be a cause of this sound, which there can be no doubt is owing to the friction of the blood on the arterial tubes.

In inflammation of the arteries the impulse is, in general, increased; and in cases of deposition of caseous or calcareous matters, along with an occasional increase of impulse, very often a short abrupt sound is present, exactly similar to that produced in the experiment mentioned, greater or less in degree according to the extent of the disease.

What we have said concerning the absence or presence of sound during disease of the heart, depending upon the quantity and rapidity of the motion of the blood, applies equally to the auscultation of the arteries.

ON THE AUSCULTATION OF ANEURISMS OF THE AORTA, &c.

LAENNEC, BERTIN, FORBES, and HOPE, have endeavoured to throw light on the diagnosis of these obscure diseases. The first author says, that "the difficulty of diagnosis is little if at all removed by the use of the stethoscope." He admits, however, that in two cases of dilatation of the arch of the aorta he found the pulsa-

tions of the tumor perfectly synchronous with the pulse at the wrist; "they gave at the same time a much greater impulse and louder sound than the mere contraction of the ventricles, and the contraction of the auricles (*the second sound*) was not at all perceptible." This kind of pulsation he called simple, in opposition to that of the heart, which is double. In these cases the tumors had presented themselves externally, so that the difficulty of diagnosis was much lessened.

Again, says LAENNEC, "if we find under the sternum, or below the right clavicle, the impulse of the circulating organ synchronous with the pulse, and perceptibly greater than that of the ventricles, examined in the region of the heart, we have reason to expect dilatation of the ascending aorta, or arch; the more so as it is extremely rare to feel the impulse of the organ of circulation beyond the region of the heart, even in cases of the most marked hypertrophy. If this phenomenon be found constant, after repeated examinations, we may consider the diagnosis as certain *."

Such is the statement of LAENNEC concerning aneurism of the thoracic aorta. With regard to the abdominal, he remarks, that aneurism there may be easily recognized by the stethoscope, by the simple and tremendous pulsations. The impulse of these tumors is generally

* Mediate Auscult.

strong, and the sound which accompanies it, says LAENNEC, "is commonly clear and loud, like that of the auricles (*second sound*), but louder." After all, however, LAENNEC appears to be very doubtful of the utility of auscultation in aneurisms of the thoracic aorta.

BERTIN has done more than LAENNEC in ascertaining the diagnosis of aneurism of the aorta; and he says, that he has been "in a measure forced to take the part of auscultation against its celebrated inventor himself. LAENNEC," continues he, "conceived that the only true pathognomonic sign of aneurism of the aorta consisted in the simple pulsation, observed by auscultation in the region of the tumor." BERTIN, however, remarks that aneurisms of the aorta are to be recognized "non par les impulsions mais le bruit de la tumeur." LAENNEC certainly mentions the noise which accompanies these tumors, but not very particularly; and his observations apply more to those which have appeared externally.

On this subject, BERTIN has the following excellent observations, and his remarks apply to thoracic aneurisms which have not yet appeared externally. He says, "That when the aneurism occupies the substernal aorta, the pulsations by which it is accompanied might be taken for those of the ventricles of the heart; but the pulsations produced by the aneurismal tumor differ from those of the heart by the vehemency of the noise which accom-

panies them, and which in a manner hurts the ear by its intensity. As the pulsations of the aorta are heard by a kind of reverberation, more or less distinct, and especially in the præcordial region, sometimes accompanied with a kind of *bruit de soufflet*, we might fancy a contraction of the arterial orifices of the heart; however we can easily avoid this error, in considering that the pulsations are much stronger in the region corresponding to the aneurism than elsewhere; in fact, there exists in the nature of the pulsations of the aorta characteristics so distinct, that it appears astonishing to us that any one can mistake them, having once heard them. But we must confess that these characteristic differences are difficult to describe; they cannot be represented by words, and the ear alone, by a sort of medical tact which is proper to it, is capable of perceiving them, of analysing them *.”

BERTIN has as it were brought us a step nearer to the correct auscultation of thoracic aneurisms, and has rendered more certain what LAENNEC pronounced with hesitation.

Dr FORBES mentions three cases in which there were increased pulsation and sound, about the top of the sternum, and under the right clavicle, found to coexist with dilatation of the ascending aorta or arch; but he does not appear to have placed much confidence in such indi-

* Mal. du Cœur, &c.

cations as diagnostic of aneurism of the aorta. Dissection proved, however, that his diagnosis was correct; and these cases, though few in number, are confirmatory of what has been stated by the two former authors *.

Dr HOPE is the latest author on this subject that we are aware of. He has given a very distinct account of the various kinds of aneurisms of the aorta, their symptoms, and auscultation; and his remarks on the latter subject appear to us to be more minute than those of any other author.

From extensive observation, he draws the following conclusions concerning the auscultation of thoracic aneurisms; and these we shall give without abbreviation.

“ According to my experience,” says Dr HOPE, “ the cylinder is scarcely less capable of affording decisive indications of pectoral than of ventral aneurisms. It is unimportant whether the pulsations be simple or double, for, though double, they may, I believe, be discriminated from the beating of the heart, by unequivocal characteristics, viz. the first sound coinciding with the radial pulse, is invariably louder than the natural ventricular sound, and generally than the most considerable concomitant bellows’ murmur.

“ On exploring the aneurismal sound from its source towards the præcordial region, it is found to decrease

* Original Cases.

progressively, until it either become totally inaudible, or is lost in the predominance of the ventricular sound. Now, if the sound emanated from the heart alone, instead of decreasing, it would increase, on approximating towards the præcordial region.

“ The second sound actually does sustain this progressive augmentation, on advancing towards the heart ; and as its nature and rhythm are found to be precisely similar to those of the auricles (*second sound*), it is distinctly recognized as the auricular sound (*second sound*). This second sound, therefore, corroborates rather than invalidates the evidence of aneurism afforded by the first ; for, if both proceeded from the heart, both would sustain the same progressive changes of intensity on receding from it.

“ Another distinctive characteristic of the aneurismal pulsation, is the peculiar nature of the sound. It is a deep hoarse tone, of short duration, with an abrupt commencement and termination, and generally louder than the most considerable bellows-murmur of the heart. It accurately resembles the rasping of a sounding board, heard from a distance : whereas the sound occasioned by valvular disease of the heart has more analogy to the bellows' murmur, being somewhat soft and prolonged, with a gradual swell and fall. The abruptness of the aneurismal sound, compared with the prolonged swelling cha-

racter of the ventricular murmur, is owing to the latter being generated by a gradual muscular contraction, while the former is due to the sudden propulsion of fluid through a tube naturally possessed of little elasticity, and rendered still more unyielding by disease.

“ The loudest aneurismal sound is occasioned by dilatation, and it has more of the grating or rasping character in proportion as the interior of the vessel is more overspread with hard, and especially osseous asperities. When the dilatation is confined to the ascending aorta, the sound, impulse, and purring tremor, are stronger on the right than on the left side of the neck. Old aneurisms, the parietes of which are thickened by fibrinous depositions, yield only a dull and remote sound. In all cases of dilatation, and in the majority of sacculated aneurisms, the sound is loudest above the clavicles, even though the impulse be stronger below. In some instances of the sacculated species, it is louder on the side of the neck opposite to that where the tumor exists. I have found this to proceed from two causes, first, disease of the inner coat of the aorta, anterior to the tumor ; secondly, the interposition of the sac, thickened with fibrinous layers, between the aorta and the superclavicular region, whence the source of sound was unusually remote on the side affected. The sound of aneurism is, in most instances, audible on the back ; and when the tumor oc-

copies the descending aorta, and is extended along the spine, it is often louder behind than on the breast. If, in the back, it possess the abrupt rasping character, the evidence which it affords is almost positive; for the loudest sounds of the heart, when heard on the back, are so softened and subdued by distance as totally to lose their harshness *."

Such are the ingenious observations of Dr HOPE on this obscure subject, which, taken in conjunction with those of the authors formerly mentioned, may be considered as affording the means of a tolerably exact diagnosis in cases of thoracic aneurism.

We have had little experience in the auscultation of these diseases, so are not prepared to give an opinion on the subject; but, at the same time, we would remark, that the diagnosis of aneurisms by auscultation presents much greater difficulties than the diagnosis by auscultation of almost any other disease to which it has been applied; and it will not be possible to make similarly minute observations to those of Dr HOPE until after long and steady experience; besides, as aneurisms of the aorta, at least to any great extent, are rare, when compared with any other disease of the chest, so the difficulty of attaining experience in the diagnosis of such diseases is

* London Med. Gaz. 1829.

thereby much increased, laying entirely aside their natural obscurity. In several cases we have verified the existence of the peculiar sound, described as generally occurring in aneurismal tumors; and have likewise given an account of one case, in which there was almost no sound, in consequence of the great approach to a natural cure*; and at present we know of another, in which the sound is nearly or entirely absent, probably from the same cause.

What has been said concerning auscultation of the aortic aneurisms, equally applies to all arterial aneurisms, in whatever part of the body these may occur.

Among the subjoined cases will be found an account of an aneurismal varix, or varicose aneurism, with a description of the peculiar sounds, heard on applying the ear or stethoscope to the tumor, which are supposed to be pathognomic of these diseases.

* Edin. Med. and Surg. Journal, No. 103.

CHAPTER VI.

ON OTHER USES OF AUSCULTATION BESIDES THOSE
ALREADY MENTIONED.

THERE are several other applications of auscultation which might be noticed. Some of these, however, appear to be equally useless as absurd. The stethoscope has been used in the following different ways, viz. 1. To discover the sounds of the fœtal circulation; 2. In the diagnosis of fractures; 3. In the detection of urinary calculi; 4. In abscess of the liver; and, 5. In diseases of the tympanum and eustachian tube. We shall only notice the two former.

SECTION I.

AUSCULTATION OF THE SOUNDS YIELDED BY THE FŒTAL
CIRCULATION.

M. MAYOR, it appears, was the first who heard the pulsation of the heart of the fœtus, and was able to tell in this way whether the fœtus was dead or alive.

M. KERGADEDEC was the next who wrote upon this subject, and his remarks are very curious. He says that the action of the fœtal heart is marked by double pulsations, like those of the adult, only much more rapid, being usually double that of the pulse of the mother. These pulsations are distinctly audible in the sixth month, and sometimes a little earlier. The place where they are heard varies with the position of the fœtus. The space over which pulsation is heard is commonly very extensive, being frequently about a foot in length, and three or four inches in width. It is always easy to determine the precise point of pulsation, from the increased or diminished intensity of the sound as we approach or recede from it. The sounds sometimes become inaudible for hours, or even for days. The excitement of the circulation of the mother seems to have little or no effect on that of the fœtus.

In cases of pregnancy, M. KERGADEDEC discovered in the region of the uterus the presence of a bellows-sound, synchronous with the pulse of the mother, but without any impulse. This sound is always heard at the same point in the same person, but varies in each. It is heard over a space less in extent than the fœtal sound, and usually over a space of three or four inches square.

This sound becomes perceptible about the fourth month, and is heard generally on the side opposite to that on

which the fœtal pulsation is perceived; but this is said not to be constant.

LAENNEC is of opinion that the sound in question does not originate in the placenta itself, as is supposed, but that it exists in the chief artery distributed to this organ. Dr OLLIVRY, he adds, proved by examination after parturition, that the point where the bellows-sound was observed corresponded exactly with that in which the placenta was implanted. Dr OLLIVRY likewise states that the sound ceased the very moment that the umbilical cord was cut.

From the observations above noticed, it appears that two or more fœtuses may sometimes be detected; but the sounds are much more delicate than those heard in the auscultation of the chest.

We have had an opportunity of verifying the existence of the sounds mentioned, only in two cases, and these nearly at the full period. In the one, on applying the stethoscope over the distended uterus, a double sound, analogous to what has been described as that of the fœtal heart, was heard about 140 times in a minute, while the pulse of the mother was between 70 and 80. In the other case, on applying the instrument over the right side of the uterus, that described as the placental sound was distinctly heard, quite as loud as, and very much resembling, that caused by aneurism. This sound coincided

with the arterial pulsation of the mother. Our examination of these cases, however, was by no means minute, else perhaps both the double and the placental sound might have been discovered in each *.

There can be no question that in doubtful and obscure cases of pregnancy, and in extra-uterine conceptions, this application of auscultation will aid the formation of a correct diagnosis; and we have seen more than one case in which it might have been used with considerable advantage †.

* Since the above was written, we have had, through the kindness of Professor HAMILTON and Mr MOIR, an opportunity of examining three cases, nearly at the full period, in the Lying-in Hospital of this city.

In the first case, the placental sound was heard about the left iliac region, but the double sound was not perceived.

In the second, the double sound was heard a little above the left iliac region, 144 times in a minute, while the pulse of the mother was 100. The placental sound was likewise heard, in this case, towards the right iliac region.

In the third case, the double sound was heard about the left iliac region, 128 times in a minute, while the pulse of the mother was 68. The placental sound was not perceived in this case.

† For more information on this subject, we beg to refer to an excellent paper by Dr FERGUSON, in the Dublin Medical Transactions, vol. i, new series, 1830, where several cases are given.

SECTION II.

ON THE DIAGNOSIS OF FRACTURES.

M. LISFRANC, in his "Memoirs sur de nouvelles applications du Stethoscope," proposes the application of auscultation for the purpose of ascertaining the presence of fractures. The advantages of this use of the stethoscope are,

1. That it enables us to detect the crepitation of the fractured bones, with a far less degree of motion of the parts, and consequently with much less pain to the patient, than is necessary to render the same audible to the naked ear.

2. It enables us to detect the presence of obscure fractures, which otherwise we might remain ignorant of.

The slight pressure of the ear on the stethoscope in the neighbourhood of the fractured bones, appears to be sufficient, in many cases, to produce a distinct crepitus. The crepitus of the more solid bones is sonorous, and has been compared to the breaking a piece of wood across the knee. That of the spongy bones is duller, and resembles the sound of a rasp on wood, except that now and then the noise is broken by sounds of a clearer kind, like those afforded by the compact bones, only not so loud.

The crepitus is loudest in the neighbourhood of the fracture, and diminishes as we recede from it; but it may be heard at a great distance from the fracture when this is in the compact part of a long bone; and, in cases of fracture of the femur, the crepitation is said to be heard even on the skull.

The sound from oblique fractures is stronger than from those which are transverse. When one end of the fractured bone rides over the other, the sound is obscured; and in some cases not perceived without slight extension of the limb.

If the fracture be comminuted, the sensation as of distinct portions of bone is conveyed by the stethoscope. When fluids are effused round the fracture, a gurgling is combined with the crepitation, when the bones are moved; and this has been compared to the sound produced by walking with a shoe full of water.

When, from the great thickness of the surrounding soft parts, the sound is rendered obscure, it becomes more perceptible by the application of the stethoscope on the point of the bone nearest the skin.

We have verified in several instances these statements of LISFRANC, and believe that in some rare and very obscure cases of fracture, the diagnosis may be rendered more satisfactory; at the same time we are aware, that, for the most part, fractures, especially those of the ex-

tremities, are so evident as in general to be at once recognized by the surgeon *.

• It has been recommended that auscultation should be applied in the diagnosis of diseases in the lower animals. Such would be highly useful, and this department of auscultation we leave to the veterinarian, in the hopes that ere long we shall see some light thrown by his means upon the diagnosis of pectoral complaints in these animals, hitherto so very obscure. In the mean time, what has been said with regard to the various signs of disease in man, will, we believe, apply to a certain extent to the lower animals also. Such we infer from their structure, not from any experience in this application of auscultation.

It may here be mentioned, that we have just seen, in the *Edinburgh Medical and Surgical Journal* for October, a paper on the Actions of the Heart, by STOKES and HART, which, had the prior sheets of this essay not gone to press, we ought and would have noticed.—*September 28. 1830.*

CASES

ILLUSTRATIVE OF AUSCULTATION.

IN the following Cases most of the signs made known by auscultation are illustrated. Auscultation and, in general, percussion have been used in all, but with various degrees of minuteness in each. The cases are, for the most part, given in full, without the treatment, but the remarks are confined to the correspondence between the auscultation and percussion, and the morbid appearances. Moreover, as a better method of conveying an idea of some of the latter than words could do, a few sketches, which we have from time to time taken from the parts themselves, have been given.

With the exception of a few cases, we have had an opportunity in every instance of verifying the correspondence between the morbid appearances and the stethoscopic signs.

CASE I.

CATARRH.

W. B., a woman, æt. 30, October 16. 1829. Has been subject for a long time to dropsical complaints. At present complains of pain at the lower and anterior part of thorax and epigastrium. Breathing frequent; occasional severe cough, with scanty mucous expectoration. Pulse 100, rather sharp. Little urine passed. Slight œdema of legs. Strong mucous rale heard over the right side of chest anteriorly; vesicular respiration, heard in the same situation on left side, natural. Sound, on percussion, on both sides posteriorly, rather dull, and sound of respiration there, faint, but nowhere absent.

17th, Breathing still hurried and noisy. Pulse 96, soft, easily compressed. Strong mucous rale heard generally over the chest; expectoration difficult, scanty, mucous. Is drowsy.

Symptoms continued much the same; and she died on the 18th.

Examination, 19th October.—There was a considerable quantity of serum in both sides of the chest. The bronchi of both lungs were loaded with mucus, and the mu-

cons membrane was of a redder colour than natural. Both lungs were œdematous to a great extent.

Remarks.—The mucous rale, in this case, indicated the presence of this fluid in the bronchi. The dull sound on percussion, and faint sound of vesicular respiration, were probably caused by the fluid in the chest.

CASE II.

CATARRH.

J. W., a woman, æt. 22. Has been subject to severe cough, accompanied with mucous expectoration and frequent dyspnœa for several weeks. No pain. Breathing hurried and noisy; mucous, sibilous, and sonorous rales heard anteriorly and posteriorly. Pulse quick, and rather feeble. Had been subject to dropsical complaints for some time.

Post-mortem Examination.—The mucous membrane of the bronchi was more vascular and redder than usual, and loaded with a muco-purulent fluid. Both lungs, particularly the right, were infiltrated with serum, especially at their posterior parts. There was a considerable

quantity of serum in the right side of chest, very little in the left. No tubercles.

Remarks.—The state of the bronchi accounts for the various catarrhal rales heard during life; which in part may have been owing to the presence of mucus, in part to tumefaction of the bronchial membranes.

CASE III.

CATARRH AND EMPHYSEMA.

J. S., a man, æt. 68. Has great dyspnœa, little cough, and scanty expectoration. No pain in the chest. Dyspnœa immediately increased on the slightest exertion. Respiration bronchial, with sonorous rale over both sides of the chest upon inspiration, and is prolonged during expiration. Pulse 72, full, firm. Feet and ankles œdematous. Says the dyspnœa has been urgent during the last few days, but has been subject to it, more or less, for three or four years.

Examination.—Lungs generally, but slightly, emphysematous. Bronchial tubes reddened and dilated. A mucous fluid was found in the bronchi.

Remarks.—In this case the respiration was heard bronchial, probably in consequence of the dilatation of the bronchi. The sonorous rale and graduated expiration were either caused by the presence of the mucus, or thickening of the inflamed mucous membrane, in the smaller bronchi.

CASE IV.

CATARRH AND EMPHYSEMA.

M. C., a woman, æt. 40, November 19. 1829.—Has occasional severe paroxysms of cough, which are always worst at night, and aggravated by any unusual exertion; accompanied with dyspnœa, palpitation, and expectoration of a muco-purulent fluid. Breathing frequent. Pulse 120. Complains of pain below the left mamma, increased on deep inspiration. Face slightly livid. Has been subject to occasional cough and dyspnœa for about eleven years, and she has generally been most distressed during damp weather. Her complaints have become much aggravated within the last six months, since which time she has observed slight œdema of her legs. Has twice expectorated blood within the last month.

20th, The whole chest sounds unusually well on percussion, except in the region of the heart, where the dul-

ness of sound is more extensive than usual. Slight sonorous rale is heard, chiefly during expiration, and vesicular respiration is more indistinct than usual, especially over the whole of the right side. Pulsation of the heart is, to the hand, more diffused, but less distinct than natural. Much tenderness in the anterior and lateral regions of the left side of the chest. Breathing easiest when she sits inclined forward. Expectoration profuse, tough, and muco-purulent.

21st, Difficulty of breathing increased; and she died this morning.

22d, *Examination*.—General emphysema of both lungs. These did not collapse on the thorax being opened, and received the impression of the finger, on pressure, without much crepitation. They both contained a little serum towards their posterior parts. The bronchial ramifications were clogged up with tenacious mucus. The emphysema was, generally speaking, of the vesicular kind, and was most distinct towards the anterior parts of the lungs. One small bulla was observed. Heart nearly natural. The lungs of the left side extended unusually over it. There was no serum in the cavities of the chest.

Remarks.—The emphysema was indicated by the in-

distinctness of the vesicular respiration, with the loud sound on percussion. The presence of tenacious mucus accounts for the sonorous rale.

CASE V.

CATARRH AND EMPHYSEMA.

W. H., a man, æt. 44. November 17. 1829.—Has dyspnœa and cough in paroxysms, with mucœ-purulent expectoration. Breathing accompanied with a wheezing noise. No pain in the chest, but occasionally a sense of heat within it. Sound on percussion over the chest is good. Has frequent rigors, occasionally followed by sweating. Pulse 100, full, and soft. Has been subject to similar complaints for several years. Present attack of about three weeks standing, and was, he believes, brought on by exposure to cold.

18th, Breathing more frequent and shorter, with mucous rale; less cough. Countenance somewhat livid. Pulse 108, full, and soft.

19th, Expectores much thick mucus. Cough frequent. Respiration 30 in a minute, Pulse 96, full and soft.

20th, Cough rather less. Respiration 36, short. Face

flushed, with some lividity. Slight delirium. Pulse 108, soft. Mucous and subcrepitating rales heard in left side of chest, laterally and posteriorly. The right side more resonant on percussion than the left. Vesicular respiration there, faint; no rale.

21st, Less cough; breathing more frequent. Pulse 114. Slight lividity of face. Vesicular respiration very weak over the lower part of right side, although sound on percussion is good.

22d, Breathing continued frequent, and debility increased, with much sweating. Dyspnoea likewise continued urgent, with little expectoration, and he died about 8 A. M.

Examination, 23d.—Both lungs were generally emphysematous, and the emphysema was chiefly of the vesicular kind; but along the edges of the anterior parts of both lungs there were numerous small bullæ, arranged close by each other, presenting very much the appearance of rows of glass beads. (See Plate III. Fig. 1.* *a a*.) The posterior part of both lungs, especially the left, contained a considerable quantity of serum, and there was muco-purulent matter in the bronchi. The lungs did not collapse on the thorax being opened. Some of the bronchi were enlarged, and these were generally redder than natural. A little serum was found in both sides of the chest.

Fig. 1.

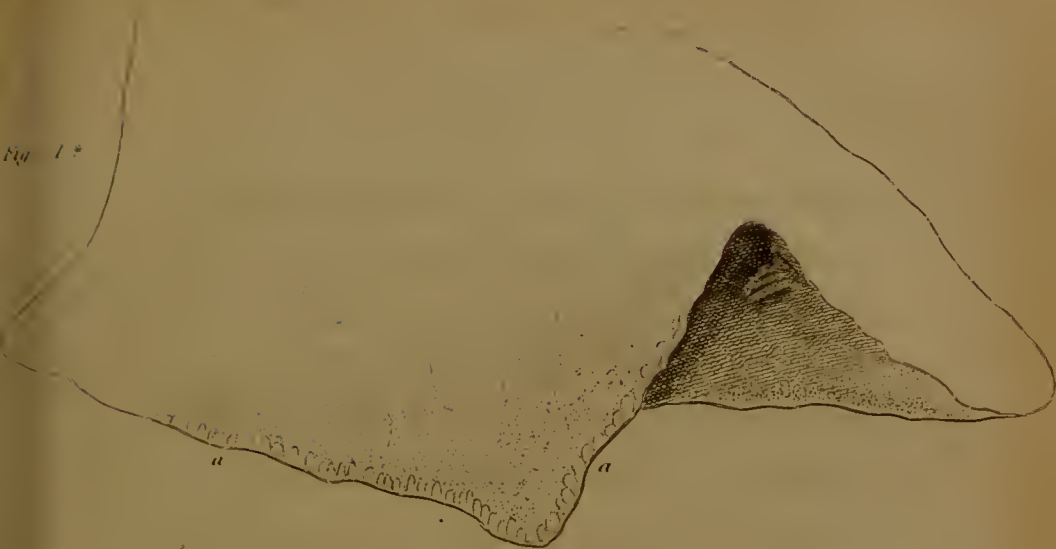


Fig. 2.



Fig. 1.



Remarks.—The greater resonance on percussion, and the faintness of the vesicular respiration, in this case, agree well with the emphysematous state of the lungs. The suberepitating rale heard in the lower part of the left lung, was either owing to the presence of slight œdema, or to the emphysematous state of the parts, perhaps from both, but probably from the first cause, the emphysema not being interlobular, and being without bullæ, except at the edges. The mucous rale heard elsewhere was certainly in consequence of the large quantity of mucus present.

CASE VI.

CATARRH, EMPHYSEMA, AND PNEUMONIA.

J. D., a woman, æt. 30, November 5. 1829. Has great cough and dyspnœa, with copious mucous expectoration. Pain under the sternum, aggravated by cough and deep inspiration. Headach, occasional palpitation, flushing of face, and slight nausea; considerable sweating at night, at which time all her symptoms are aggravated. Pulse 104. Has been subject to similar attacks, of less severity than the present, every winter, for some time back; but she enjoys tolerably good health in summer. The present attack commenced about 14 days ago.

6th, Symptoms much as before. Some lividity of countenance. Expectoration thick and floeculent. Pulse 100, full, and moderately firm. Lies easiest on the left side. Percussion posteriorly natural; and there, at many points, a sharp mucous or suberepitating rale is distinctly heard, which is also evident under the clavicles. Sound of vesicular respiration generally faint.

8th, Dyspnœa less, cough as before. Pulse 92, full. Mucous rale heard on both sides of the chest, but especially on the left.

10th, Much debilitated. Lies on back; countenance livid, and much depressed; extremities cold, and pulse imperceptible at wrist. Respirations 23.

11th, Died yesterday about 2 P. M.

Examination.—Lungs collapsed very little on the chest being opened. They were generally emphysematous, and this was most conspicuous at their edges, but it existed for the most part throughout both. The lungs did not crepitate much on pressure between the finger and thumb, but imparted a distinct doughy sensation. The emphysema was chiefly vesicular, but there were several small bullæ (See Plate III. Figs. 1. & 2.* *a*), and here

* Fig. 2. is the opposite side of the same portion of lung as that from which fig. 1. was taken.

and there, at the edges, distinct portions of interlobular emphysema (*b*).

The larger bronchi were much redder than natural, and contained a larger quantity of muco-purulent fluid. The lower and back part of the right lung was hepatized to a considerable extent, being in the second stage of pneumonia. There were many old firm adhesions of the back parts of both lungs to the pleura costalis.

Remarks.—Emphysema, pneumonia, and catarrh, were present, in this case, at the same time.

The natural sound, or percussion, heard on the 6th, with the generally faint sound of vesicular respiration, indicated the existence of the emphysema. The subcrepitating rale may probably have been owing to the presence of pneumonia, at some points; at others, it may have occurred in consequence of the emphysema. It very probably was present here in consequence of both. The mucous rale heard on the 8th may have been in consequence of an increase of this fluid.

CASE VII.

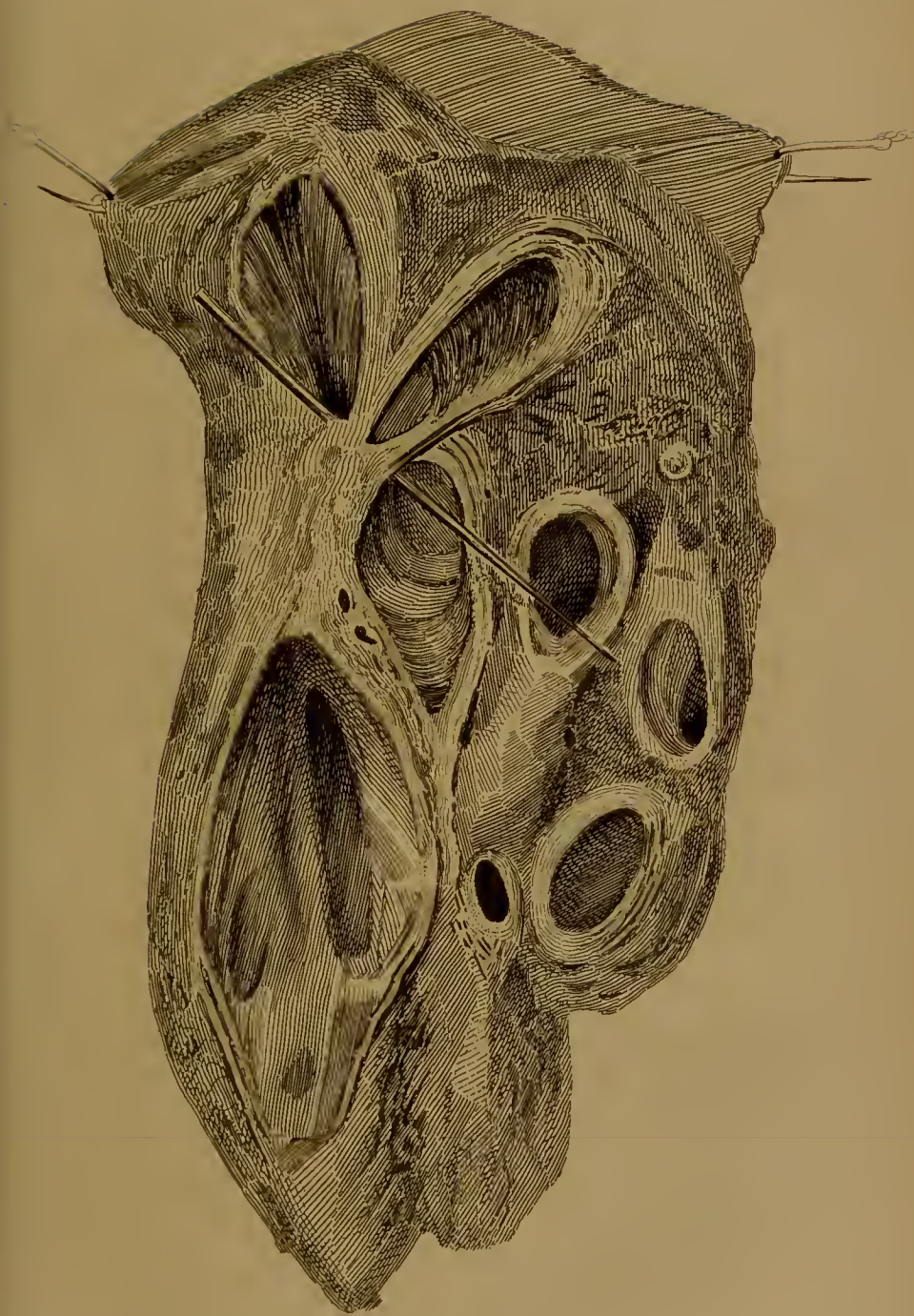
CATARRH WITH GREAT DILATATION OF THE BRONCHIAL
TUBES.

———, a man, æt. about 45. April 1830.—Had been subject to pectoral complaints, particularly to severe cough, with profuse expectoration and occasional dyspnoea, for about 10 years; lately, however, all his symptoms became much aggravated, and he lay for the most part on his left side. At this time his cough was very troublesome, with profuse muco-purulent expectoration; and he likewise became subject to œdema of legs, and other dropsical symptoms.

On examination by the stethoscope, a few days before death, pectoriloquy and cavernous rale were heard over a considerable part of the right side of the chest, particularly anteriorly and laterally.

Catarrhal rales were heard pretty generally over the left side of chest.

Examination.—There were general and firm adhesions of the right lung to the pleura costalis; and this lung was rendered completely unfit for the performance of its function, being throughout in a state of disease.





Almost every considerable bronchial tube was dilated, pyriform, and formed a *cul de sac*, somewhat resembling the finger of a glove.

These enlargements, which were very numerous, and throughout the whole extent of the lung, varied in size from about two inches in diameter downwards.

The usual fibrous and mucous membranes, forming the bronchial tubes, were distinctly observed in these cavities, which had not the slightest appearance of being tubercular.

The substance of the lung between these dilatations was quite condensed, and seemed impermeable to the air. It had much the appearance of a compressed lung in pneumothorax. (See Plate IV., where a portion of the lung is represented *.)

Remarks.—This is one of those rare cases in which great dilatation of the bronchi is found to coexist with chronic catarrh.

The cause of the pectoriloquy and cavernous rale, heard diffused over a great part of the right side of the

* We are indebted to Professor ALISON for this case, and the drawing from which the accompanying sketch was taken; and we take this opportunity of acknowledging the many favours and uniform kindness which that gentleman, as well as his friend Dr GREGORY, have conferred upon us during the prosecution of this subject.

chest, is easily explained; the former by the presence of the dilated bronchi, and the latter by the mucous-purulent fluid and air existing in these.

CASE VIII.

CATARRH WITH TUBERCULAR DEPOSITION IN THE PLEURA.

W. M., a woman, æt. 65. April 9. 1829.—Has frequent severe cough, with profuse mucous expectoration, more troublesome at night than during the day; likewise aggravated when lying on the right side. Dyspnoea on any unusual exertion. Pulse 120, small. Breathing quick. Has been subject to these complaints for several years, but lately they have become much more severe.

10th, No pain on full inspiration; cough and expectoration continue. Sound on percussio duller on left side posteriorly, than on right. Left side contracted to a considerable degree, and moves little upon inspiration. Sound of respiration everywhere faint upon left side. Slight mucous rale heard at different points on both sides of the chest.

17th, Within the last few days her dyspnoea has become very urgent. Pulse weak, and her extremities

cold, with lividity of the lips, and she died yesterday evening.

Examination.—There was much mucus in the bronchi, and these were apparently more vascular than natural. The right lung was otherwise tolerably healthy. The left was much compressed against the mediastinum, but it partially adhered anteriorly to the pleura costalis. Between the parietes of the chest and compressed lung there was a considerable quantity of a curdy purulent looking fluid; and the cavity in which this was lodged was lined with a caseous tubercular deposit, projecting from its walls. There was likewise a large calcareous deposition lying immediately within the costal parietes of the cavity, and here and there similar earthy deposits of a smaller size were found. The fluid and solid effusion occupied nearly the centre of the left side of the chest, and extended over a considerable space.

Remarks.—In this case, the faint vesicular respiration and dull sound on percussión corresponded with the morbid state of parts described above. The mucous rale was doubtless owing to the presence of mucus in the bronchi.

CASE IX.

PNEUMONIA.

A. C., a man, æt. 59, July 4. 1829.—Face flushed. skin hot and dry. Pulse 120, full, and sharp. Tongue white and dry in the centre. Much thirst. Has frequent severe cough, accompanied with profuse tenacious expectoration, of a brownish hue. Respirations 44. No pain of chest, not even on coughing or full inspiration. Percussion over the right side of the chest generally duller than on left, and the ribs on that side are elevated very slightly during inspiration, while those of the left side are unusually so. The râle crepitant is distinctly heard all over the right side of the chest, except at the lower and back part, where the sound of respiration is nearly inaudible, but the râle crepitant is still slightly heard. Puerile vesicular respiration heard all over the left side of the chest.

Has never had pain in the chest. Has been ill about eight days, and states that he was previously exposed to cold and wet. Has lived intemperately. Thinks he had a similar attack some years ago.

5th, Cough less. Pulse 120, strong and sharp. Skin hot, and face flushed. Has no pain of chest. Respira-

tions 52. Expectoration less profuse, of a uniform brown colour, and very tenacious, having a gelatinous appearance, inclosing very few air-bells. Stethoscopical signs much as yesterday.

6th, Cough nearly gone. Respiration rather less frequent. Pulse 116, softer, still of good strength. Tongue dry. Râle crepitant diminished anteriorly, in the upper part of the right side of chest. Râle crepitant still well marked laterally and posteriorly. Sound on percussion of that side of chest still dull. Puerile vesicular respiration heard over the left side of chest, without any râle. Expectoration frothy and tenacious. Bronchophony, amounting almost to pectoriloquy, heard in many points over the right side.

7th, Breathing became more oppressed; pulse small, with slight delirium; and he died about nine this morning.

Examination 28 hours after death.—Universal, firm, and close adhesions of pleura pulmonalis to the pleura costalis, of the right side of chest. Right lung almost universally hepatized. When cut into, a reddish-grey purulent looking fluid issued from the upper part of the lung, which was at the same time very friable, and broke down easily between the finger and thumb. The anterior edge of this lung crepitated slightly, but was quite hepa-

tized; the lobes adhered firmly to each other. The lower part of this lung was soft, and at many places almost pulpy, apparently disorganized, and approaching to a state of gangrene, but the fœtor was not distinct. Here and there the inflammation seemed to have proceeded farther than was generally the case, for there were several spots of a yellowish colour, which seemed to be infiltrated with pus, and these were more friable than the other parts. There was no large collection of pus, or, in other words, no abscess; but this fluid could be squeezed from the lung very generally. Almost every part of this lung tried, sank in water; and several places, when cut into, presented a dark red colour, being apparently gorged with blood, from which, on being pressed, a sero-sanguinolent fluid was found to issue. Comparatively few air-bells were seen in the right lung. There was some mucus in the bronchial tubes, and the lining membrane of these was redder than usual. The left lung was quite healthy in its structure, and collapsed on the thorax being opened, which was not the case with the right.

Remarks.—The stethoseopical indications, in this case, were very exact, as proved by the examination. The râle crepitant being heard generally over the right side of the chest, indicated the inflammatory action which

was going on, and proved to have existed by the hepatization; while its feebleness at the lower and back part of the right side indicated that the inflammatory action had proceeded farther there, which was also proved by the examination.

The dulness on percussion over the right side, indicated that hepatization had already taken place to a considerable extent; and indeed patches farther advanced were found throughout the lung.

Bronchophony heard on the 6th, indicated the presence of hepatization to a great extent.

The puerile vesicular respiration, heard in the left lung, indicated the increased action, and, at the same time, healthy condition, of this organ; and the examination proved this to be correct.

It may be remarked, that, in this case, there never had been any pain in the chest.

CASE X.

PNEUMONIA.

C. M., a man, *æt.* 45, August 10. 1830.—While under treatment for difficulty of deglutition, believed to depend upon stricture of the *œsophagus*, he suddenly became af-

feeted with difficulty of breathing; which, from its stridulous character, apparently depended upon an affection of the larynx. This, however, abated, but still his breathing continued frequent and short, accompanied with tenacious mucous expectoration. Pulse 120, rather sharp. Skin warm. Appetite impaired.

On the evening of the 14th he complained of considerable pain in the lower part of right side of chest. At this time his breathing was more frequent, and his pulse rapid, and softer than before. On applying the stethoscope to the right side of chest, the râle crepitant was heard generally over its lower part, where he principally complained of pain. The respiration in the upper part was puerile. The left side, in consequence of the position of his bed, and the feeble state of the patient, was not examined.

All his symptoms became more aggravated, and he died about noon on the 15th.

16th, *Examination 24 hours after death.*—There were a few old and firm adhesions of both lungs to the pleura costalis. The lungs appeared more voluminous than usual, because they did not collapse much on the chest being opened, especially at their lower parts. On an incision being made from the apex of each to its base, the lower third at least was found to be in a state of he-

patization, grey and red mixed. Farther up, the lungs were in a state of sero-sanguinolent engorgement, and this extended to about a third from the apex of both. There was a slight serous effusion in each side of the chest.

Remarks.—The râle crepitant, in this case, indicated the inflammatory action going on in the chest; and we have no doubt, had the other side been examined, that the same indication would have been found there likewise; the left lung being in exactly the same state as the right.

CASE XI.

PLEURO-PNEUMONIA.

J. B., a man, æt. 47, August 20. 1830.—States that about a fortnight since, after exposure to cold and wet, he was seized with a severe cough, exciting pain at the lower part of the right side of chest, accompanied with acute febrile symptoms.

Has at present severe cough, exciting pain in the same region of chest, increased on deep inspiration. Expectoration copious, and consisting of viscid mucus. Febrile symptoms still present. Lower part of right side

of chest is dull on percussion, and râle crepitant is heard on that side.

21st, Subcrepitating rale, mixed with mucous rales, heard over the middle of lateral part of right side of chest.

23d, Expectoration copious, mucous, tenacious, and partly brownish. Pulse 104, weak. Cough very urgent. Pain of side easier.

24th, Pulse 120, of better strength. Respiration more hurried. Expectoration diminished and less tinged brown. Right side of chest generally dull on percussion.

25th, Pulse 132, feebler. Dyspnoea. Cough and expectoration diminished. Occasional slight delirium.

26th, Breathing became more laborious yesterday evening, and he continued to sink, and died about five this morning.

27th, *Examination*.—The right lung adhered to a great extent, by means of its pleura, to the pleura costalis. The lower and back part was the only portion not adherent, and this contained several ounces of turbid and flaky serum. The surface of the pleura, at this place, was thickly coated with an irregular layer of recent lymph. The two upper thirds of the right lung were quite dense, and chiefly in the third stage of pneumonia; there were portions, however, in the second stage only. It was generally of an

ash-grey colour, and on being pressed a sero-purulent fluid was found to issue from it, but few or no air-bells. The lower third of this lung seemed to be in the first stage of pneumonia. It had a dark-red aspect, contained much bloody serum, and an unusual number of air-bells.

The left lung was slightly emphysematous at its anterior edges.

The bronchial tubes of both lungs were redder than usual, and contained a considerable portion of mucous fluid.

It is remarkable that, in this case, there were only two semilunar valves at the mouth of the aorta. These were proportionally larger than usual, and, although considerably thickened, and somewhat corrugated, appeared as if they could have performed their functions tolerably well. One, from immediately within which both coronary arteries arose, was larger than the other, which, however, was considerably beyond the usual dimensions.

The irregularity of formation did not extend farther, the other valves being of the usual form. The mitral valve was likewise slightly thickened, and on its larger segment there were several "vegetations." The aorta was slightly diseased in the usual manner.

The irregular formation, in this case, is exactly similar to that in a drawing given by MAYO in his *Outlines of Physiology*.

Remarks.—The dull sound on percussion, heard at first at the lower part of the chest, was probably caused by the pleuritic effusion. Latterly, the dull sound on percussion, perceived over the right side generally, may have been on account of the hepatization.

The râle crepitant indicated the inflammatory action going on in the right lung.

CASE XII.

PLEURO-PNEUMONIA.

J. B., a woman, æt. 50, August 12. 1829.—Face flushed. Expression anxious. Breathing hurried. Slight cough, with scanty tenacious expectoration. Complains of acute pain in lower part of the right side of chest, increased on pressure or deep inspiration. Percussion on the right side of chest duller than on the left; and sound of respiration generally inaudible there. Vesicular respiration heard in left side of chest, mixed with mucous rale. Inflammatory fever accompanying the symptoms mentioned.

Says she has been subject to occasional cough and expectoration for about ten years, but that her present illness is only of a few days' standing.

Has lived intemperately, and has been much exposed to cold and wet lately.

Her symptoms rapidly became more urgent, and she died on the 13th.

15th, *Examination*.—There were about three pounds of sero-purulent fluid in the right pleura. Over the pleura pulmonalis and pleura costalis there was a very profuse effusion of lymph, which seemed quite recent; it was very soft, and easily separable from the pleuræ, and apparently not at all vascular. The right lung, with the exception of its lowest lobe, and portions here and there throughout the lung, was firm and hepatized, presenting a granular aspect, and very little serum issued from it on pressure. There was no purulent infiltration; the affected parts were almost entirely in the second stage of pneumonia, according to LAENNEC and others. The hepatized portions contained very few air-bells, and sank in water. The lowest lobe of this lung crepitated between the fingers slightly, and there was a good deal of serum in its posterior portion. At some places, about the line of demarcation between the hepatized and the healthy portions of the lung, there were observed, by the aid of a lens, considerable patches where the air-bells were unusually numerous, just as if they had been forced to retreat from the hepatized texture, and were all

crowded together in confusion in the neighbouring comparatively healthy texture.

The left lung was nearly healthy. There was a little mucus in the bronchi of both lungs. No fluid in the left cavity of chest.

Remarks.—The dull sound on percussion over the right side, with absence of the sound of respiration, indicated the presence of something morbid, which was proved by the examination to have been the effusion of fluid in the chest, and hepatization of the lung, towards the upper part, which is comparatively rare. The hepatization was in all probability complete when the examination was made, for no râle crepitant was heard there.

The effusion of fluid may have been too abundant to have given rise to distinct œgophony; had the examination been more minute, however, this might have been detected.

The healthy state of the left lung agrees with the indications. The slight mucous râle was accounted for by the presence of mucus in the bronchi.

CASE XIII.

PLEURO-PNEUMONIA.

C. W., a woman, æt. 20, December 4. 1828.—States that in consequence of being exposed to cold and wet, on 20th November, she was that evening seized with a severe cough, which continued until the 30th, when she was attacked with acute pain under the right mamma, extending round to the scapula of the opposite side, forwards to the sternum, and down into the hypochondriac region of the same side; increased by pressure, coughing, and full inspiration. Pulse 140, small, and firm.

5th, Delirium, yet answers questions distinctly. Says pain of side is nearly gone. Very little cough. Respirations above 40. Little apparent anxiety. Pulse 130, softer and fuller. Vesicular respiration heard in the lower part of right side of chest very indistinctly, and the sound of the voice is heard through the stethoscope altered, and resembling œgophony. Percussion on right side of chest rather dull.

6th, Restless and delirious during yesterday afternoon; more distinct this morning. Respirations 30. Pulse 120, easily compressed. Little cough. Says she has no pain of chest. Lips rather livid. Skin cool and moist.

Mucus heard in the bronchi; but she does not expectorate.

7th, Dyspnœa and pain of side. Respirations 40. Cough rather more urgent. Little expectoration. Râle crepitant heard just under the right mamma, and a sound resembling œgophony is likewise heard there.

8th, Pain of side increased. In the evening her breathing became more difficult, and she died about 8 A. M.

10th, *Examination*.—About two pounds of sero-purulent fluid were found in the right side of chest, containing numerous flakes of lymph, apparently recently effused. There was an effusion of recent coagulable lymph nearly all over the pleura costalis and pulmonalis of the right side, assuming a rounded form over the lung, at its lower part, and over the diaphragm, at which places it was rather firm, and admitted of being peeled off, displaying the serous surface in a highly vascular state. At two places there were patches of organized lymph under the recent effusion, highly vascular, and adhering firmly to the serous surface, being probably the result of some previous attack.

The lower part of the right lung was at some places condensed, crepitated little, and sank in water. It was, when cut into, of a dusky-red colour, and was partially

hepatized, in the second stage of pneumonia. There was very little mucus in the bronchial tubes.

The upper part of the right lung contained a considerable quantity of sero-sanguinolent fluid. The left lung was generally natural, but contained rather more serum than usual in its posterior portion.

Remarks.—The indistinctness of the vesicular respiration, with the dulness on percussion, indicated the presence of something morbid, which was proved to be fluid by the ægophony heard on the 5th, at the lower part of the right side, when the effusion was small in quantity; but, on the 7th, under the right mamma, indicating the increase of the effusion. The râle crepitant also indicated the presence of the inflammation of the pulmonary texture, and this was proved to have been the case by the examination.

CASE XIV.

PHTHISIS.

B. D., a female, æt. 34, May 27. 1828.—Complains of constant pain of the chest, especially of the left side. Occasional severe cough, and cannot lie upon that side, on account of the difficulty of breathing which it

causes. Scanty muco-purulent expectoration. Frequent rigors during the day, succeeded by flushing. Is subject to diarrhœa. Has great debility, and is much emaciated. Has had pains in her chest occasionally, accompanied with febrile symptoms, for upwards of three years. Six weeks ago the cough and dyspnœa became urgent. About a month afterwards the vesicular respiration was heard faintly all over the chest, mixed with various catarrhal rales. About a fortnight after this period, the vesicular respiration was not to be heard in the left side, the respiration was generally bronchial; and pectoriloquy was distinctly heard in several places under the pectoral muscle.

Her symptoms gradually became worse, the expectoration became decidedly purulent, with severe cough, and she died July 24th.

Examination.—On the right side of the chest the lungs strongly adhered to the pleura costalis, by old firm adhesions. The lungs of the left side likewise adhered to the pleura, but by recent, soft, highly vascular, adhesions. On the left side of the chest there was much tubercular matter; the lung was every where consolidated, chiefly by deposition of the latter. Many of the tubercles had become softened, and formed caverns; none of these were very large, and none were entirely empty of

fluid. One of them was lined with a fine smooth membrane. Several tubercular caverns existed under the left pectoral muscle, where pectoriloquy had been discovered by the stethoscope.

There was much tubercular matter in the upper lobe of the left lung, but none of the tubercles had yet softened, and of course there was no tubercular cavern. There were no tubercles in the lower part of this lung.

Remarks.—The catarrhal rales heard along with the vesicular respiration, were consequent upon the presence of a temporary catarrh. The bronchial respiration afterwards heard, was probably in consequence of the condensed state of the lung from tubercular matter. Caverns were indicated by the pectoriloquy.

CASE XV.

PHTHISIS.

H. S., a man, æt. 21, December 17. 1828.—Has cough, with copious viscid expectoration, tinged with blood. Says he has pain shooting from between the 5th and 6th ribs to the base of the scapula of the right side. This side is dull on percussion, anteriorly and posteriorly,

and the integuments over it are tender to the touch. Pulse 104, soft. Respirations 34. Lies easiest on the left side. Reports that, about eighteen months ago, after exposure to cold, he was seized with rigors, followed by cough, which continued until now. Six months ago, the pain of side first occurred; previous to which time, the expectoration attending the cough was tinged with blood, and continued so until within the last six weeks, when it became yellowish. A few weeks ago he vomited about three-fourths of a pound of blood.

Has frequent, though not profuse perspiration.

20th, Pectoriloquy very distinctly heard under the right clavicle.

22d, Expectoration profuse. Pain of right side continues. Pulse 108. Respirations 32. Perspiration more profuse.

26th, Expectoration tinged with florid blood. Emaciation great.

27th, Died about 11 A. M.

29th, *Examination*.—The right lung contained a large quantity of tubercular matter, in different stages. Opposite to the space immediately below the clavicle; and about two or three inches deep in the most diseased part of the lung, there existed a cavern about the size of a walnut, containing some broken down tu-

bercular matter. Still deeper, and about this situation, there was another cavern, of a similar character. The mucous membrane of the bronchi was redder than natural.

There were only a few tubercles in the upper part of the left lung.

Remarks.—There was distinct pectoriloquy in this case, notwithstanding the depth of the caverns, but the density of the lung between accounts for this. The dulness, on percussion, of the right side generally, was caused by the large quantity of tubercular matter present in the right lung.

CASE XVI.

PHTHISIS.

W. A., a man, æt. 22, 1829.—Has been subject to cough, accompanied with profuse muco-purulent expectoration for a considerable time. Has no pain in the chest. Much emaciation. Chest contracted. Voice weak. Respirations quick and short. Breath foetid. Heetic fever.

Strong mucous rale, amounting at times to cavernous rale, heard under both clavicles, particularly the left; and principally on coughing, with obscure pectoriloquy.

Examination.—Both lungs were thickly studded with tubercles in various stages, particularly in their upper lobes, where many had broken down, and were in the act of forming caverns. At the apex of each lung, were several large caverns with ragged edges, partly filled with broken down tubercular matter, and communicating freely with the bronchi. The left lung contained more tubercles than the right. There was a considerable quantity of muco-purulent fluid in the bronchi, the lining membrane of which was redder than natural. Both lungs adhered firmly to the pleura costalis, especially at their apex and back parts; the left more closely than the right.

Remarks.—The cavernous rale and obscure pectoriloquy were caused by, and indicated the presence of, the cavities mentioned, containing partly air and partly liquid. The pectoriloquy was obscure, probably in consequence of the weakness of the voice and quantity of fluid present in the cavities, which was considerable.

CASE XVII.

PHTHISIS.

J. C., a man, æt. 43, October 1. 1829.—Has severe cough, but almost no expectoration; respiration hurried. Pulse 88. Is much emaciated, and has the other symptoms usually accompanying phthisis.

7th, On applying the stethoscope beneath the right clavicle, the sound of the voice and of coughing is heard through it, more distinctly than on the other side, but no rale is heard, and the sound of respiration is distinct at the part. He never had much expectoration.

19th, The sound of the voice was still stronger than natural through the stethoscope a few days ago, or bronchophony was heard.

20th, *Examination*.—There were many tubercles in both lungs, chiefly towards the upper part, and in the right side. The upper lobe of the right lung adhered to the pleura costalis; its bronchi were dilated, and there were, besides, two small cavities, lined with a firm semi-cartilaginous membrane. These cavities were some way from the surface, which may account for the sound of

respiration being heard over them. The lower parts of both lungs were comparatively free from tubercles.

Remarks.—The bronchophony in this case may be said to have depended, in part upon the presence of tubercles, in part, and more particularly so, on the dilated state of the bronchi, and presence of the small cavities mentioned.

CASE XVIII.

PHTHISIS.

M. W., a woman, æt. 23, August 31. 1828.—Has frequent severe cough, without pain of chest, but with expectoration of purulent looking matter, having small flocculent masses mixed with it. Respiration not much disturbed. Occasional œdema of the feet, and coldness of the lower extremities. Night sweats. Distinct pectoriloquy heard under the sterno-clavicular articulation of the right side. Elsewhere the vesicular respiration is heard tolerably pure.

In the left lung, near the sternal extremity of the clavicle, cavernous rale is distinctly heard. At the humeral extremity of the left clavicle, and in the axilla, pec-

toriloquy is distinctly heard. The left side of the chest is generally painful on pressure.

She has had diarrhœa, almost alternating with sweating.

September 9, Pectoriloquy, and some cavernous rale, at the humeral extremity of the right clavicle. In the left lung there is distinct cavernous rale close to the head of the sternum, and over a space about two inches square. There is distinct pectoriloquy under the edge of the pectoralis major muscle, where it forms the edge of the axilla. There is pectoriloquy in the axilla also.

19th, There is cavernous respiration over the whole of the superior portion of the right lung. In the left lung cavernous rale and pectoriloquy are heard in the axilla, and on the axillary border of the great pectoral muscle; and from this on towards the sternum.

24th, Very severe dyspnœa. Great diarrhœa. Copious muco-purulent expectoration. Extreme weakness and emaciation. She died in the evening.

Examination.—The upper lobe of the right lung adhered to the pleura costalis. On separating this adhesion, a large cavern, which was divided by septa of pulmonary texture, occupied nearly the whole of the upper lobe. The external parietes of this cavity, where it adhered, were exceedingly thin. There were, besides,

many other caverns up and down the lung, of small size filled with purulent matter; and the lung, in general, was studded with tubercles.

The left lung likewise adhered at its upper and back part, and had its superior lobe excavated with numerous tubercular caverns. One of these caverns had apparently lately burst into the bronchi. The whole of the left lung likewise was studded with tubercular matter.

Remarks.—The stethoscopical indications in this case agree well with the morbid appearances. The adhesions of the upper lobes of the lungs rendered these in a very favourable condition for auscultation, as is always the case. The cavernous respiration heard latterly, may be accounted for by the nearly complete evacuation of the cavities at the time, which previously may have contained much softened matter.

CASE XIX.

PHTHISIS.

J. B., a man, æt. 20, July 15. 1829.—Complains of difficulty of breathing. Cough, aggravated at night and towards the morning, accompanied with expectoration

of tough mucopurulent matter. Great debility; thirst; and impaired appetite. Œdema of the lower extremities, particularly of the right foot and ankle. Pulse 130. Face flushed. Skin hot. Sweats.

Very distinct cavernous rale is heard under the left clavicle, where pectoriloquy is also equally distinct.

Says that his cough commenced about six months ago, at which time his expectoration was not purulent, but it became so about two months afterwards. His relations say that he has been subject to occasional cough for upwards of a year, and that he is the last of a family, all the members of which have died of consumption.

25th, Bowels loose; great weakness.

12th August, Extremities œdematous; diarrhœa.

15th, Diarrhœa continued, with increased exhaustion; and he died about 3 P. M.

Two or three weeks before his death, the stethoscopical signs were as before, and indistinct pectoriloquy was heard under the right clavicle.

17th, *Examination*.—The left lung adhered, towards its upper and back part, by firm adhesions to the pleura costalis. There were many tubercles in this lung; these were most numerous towards its upper part, and were almost all in distinct groups, of various sizes. Most of them were of a yellowish colour, and seemed beginning

to break down, having for the most part, a softened portion in the centre.

About the middle of the upper lobe there was a large cavern, the parietes of which, at the surface of the lungs, were only about one-eighth of an inch in thickness. The parietes generally were dense, slightly cartilaginous, and almost entirely lined with the soft membrane so often mentioned as occurring in tubercular caverns. This cavity communicated with the bronchi by many openings; it likewise communicated with a smaller cavity, lateral to it, and of a similar structure.

Throughout the lung there were several smaller caverns; many of them were ragged, being formed by tubercular matter in progress to softening. At many places, the tubercular matter was so profuse as to cause portions of the lung containing it to sink in water.

The right lung likewise contained many tubercles. There was not, however, so much tubercular matter in this lung as in the left. There were several caverns at various parts of this lung, chiefly towards its upper part; they all contained a little purulent-looking or softened tubercular matter, and were generally of a similar structure to those mentioned as occurring in the left lung. They were not so large, however, as those in the left, the most considerable being only about one-third the capacity of the large one found there. They did not communicate

so freely with the bronchi. There were slight adhesions of the upper part of the right lung to the pleura costalis. There were a few ounces of serum in each side of the chest.

The mesenteric glands were enlarged, and tubercular. The mucous membrane of the large and small intestines was ulcerated extensively. The mucous membrane was almost entirely ulcerated off the caput cæcum coli; and on the ragged edges of the remaining patches there was a line of bright vascularity. There were numerous small rounded ulcers, with elevated edges, in the mucous membrane at the lower end of the ileum, and also in that of the appendix vermiformis.

Remarks.—The caverns in the upper part of the left lung were in a very favourable state for the production of the signs mentioned, being so near the surface of the chest, and communicating freely with the bronchi; while the imperfect pectoriloquy heard at the upper part of the right side of chest agrees with the comparatively unfavourable state of the parts for the development of this sign, the cavities being smaller, and containing proportionally more fluid.

In this case there was great diarrhœa accompanying an ulcerated state of the intestines, together with disease of the mesenteric glands.

CASE XX.

PHTHISIS.

R. B., a man, æt. 37, August 29. 1829.—Has frequent cough, with copious expectoration. Appetite impaired; thirst; night sweats. Occasional vomiting after meals. Face sallow; countenance depressed; much emaciation; debility not very great. Bowels regular. Expectoration puriform. Pulse 120, small, and weak. Breathing short and hurried. Near the junction of the clavicle and sternum, at the right side, pectoriloquy and cavernous respiration can be heard over some extent. Towards the axilla, near the inferior border of the great pectoral muscle, mucous rale is heard. Over the rest of the lung the vesicular respiration is loud and distinct.

On the left side, between the mamma and clavicle, the same mucous rale is heard, more distinctly near the clavicle. Posteriorly, the same is heard in corresponding points, but not so distinctly. Bronchophony, or doubtful pectoriloquy, is heard on both sides at the supra spinal fossæ. Sound of the heart's action loud, and more diffused than usual; impulse not increased.

Complaints commenced eighteen months ago with pain in the chest. Cough and expectoration occurred shortly

afterwards, and have since continued without intermission, while debility and emaciation were at the same time increasing. His relations report that his father and grandmother died of consumption.

2d September, Severe paroxysms of cough, with great dyspnœa and vomiting. Night sweating continues. Pulse 100, small, and weak.

3d, Pectoral symptoms somewhat easier. Bowels slow; laxative pills taken without effect.

6th, Cough more troublesome; expectoration difficult.

8th, Cough and expectoration as before; debility increases; countenance depressed. Pulse 120, feeble. One liquid stool. Respiration quick.

9th, Died this morning.

Is reported to have never expectorated any blood.

10th, *Examination*.—In both lungs there were many tubercles, in different stages. In the upper lobe of both lungs there were several caverns, but these were more numerous and extensive in the right (See Plate V. Fig. 1.) than in the left (Fig. 2.), and communicated with each other, and with the bronchi, by several pretty large openings*. Their parietes were formed of the usual semicartilaginous texture, having within this a soft lymph

* For the most part, the following sketches represent a horizontal section of the lungs from the apex to their base.

membrane. The cavities were generally near the surface, but several were deep in the substance of the lungs. The lower portions of both lungs were comparatively sound. Both lungs adhered at the upper and back parts to the pleura costalis, by firm adhesions.

The caput cæcum coli, vermiform process, and lower extremity of the ileum, were the only portions of the intestines examined. In the caput cæcum there were several irregular ulcers, which seemed to have penetrated the muscular coat. There were no ulcers in the vermiform process, but a number of small tubercles occupied the inner surface of that body. Some of these had a yellowish point in the centre, and seemed beginning to soften. There was only one tubercle in the portion of ileum examined, which was the lower part; it had a yellow point in the centre. There was no ulceration in the portion of ileum examined, nor increased redness of the part.

Remarks.—The stethoscopical signs accord with the morbid appearances found after death. The caverns in the upper part of the right lung account for the presence of the pectoriloquy and cavernous respiration. The mucous rale heard lower down on this side, and also beneath the clavicle in left side, as well as the bronchophony heard at the shoulder, are attributable to the presence of the

Fig. 1.

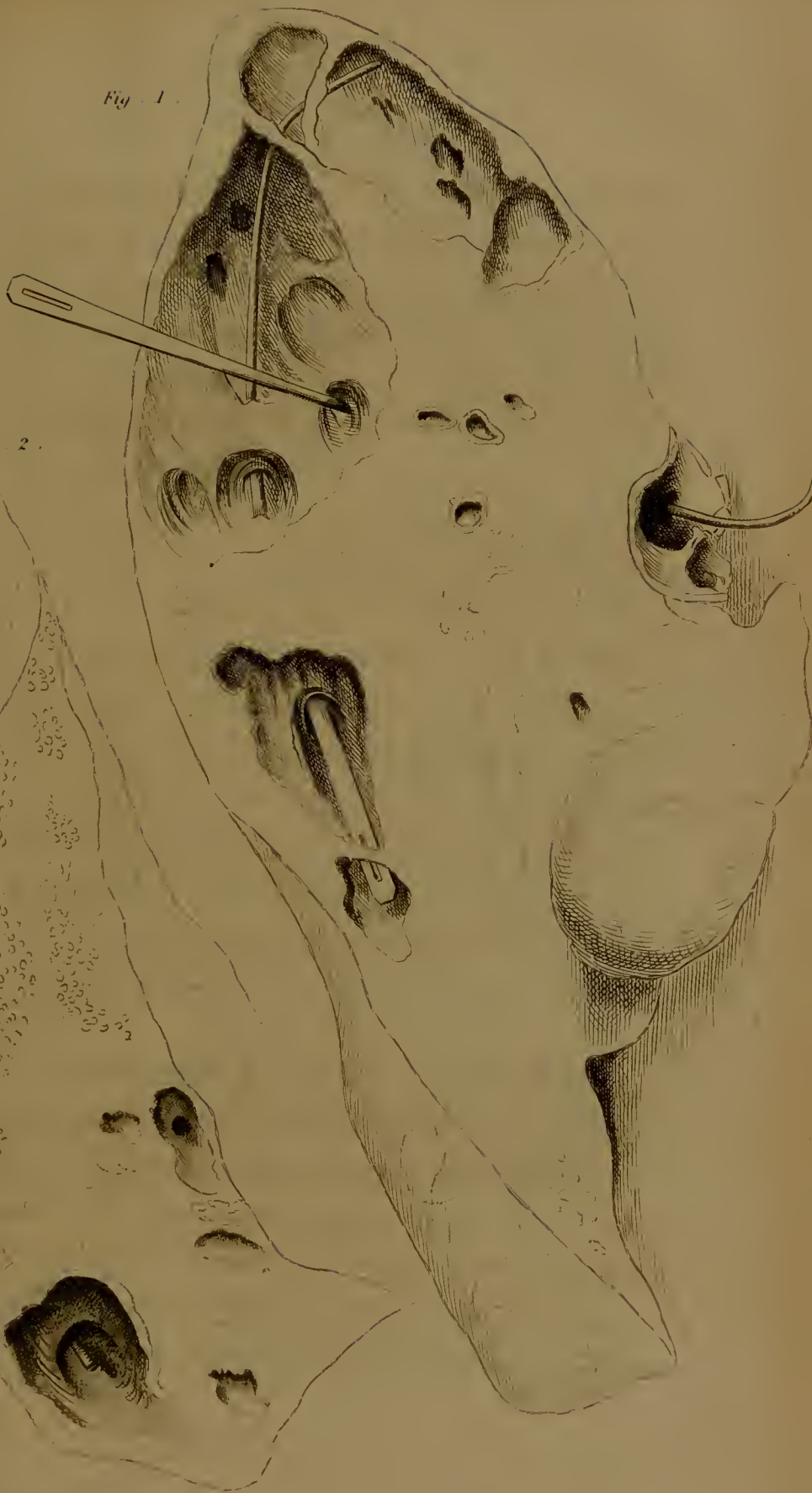
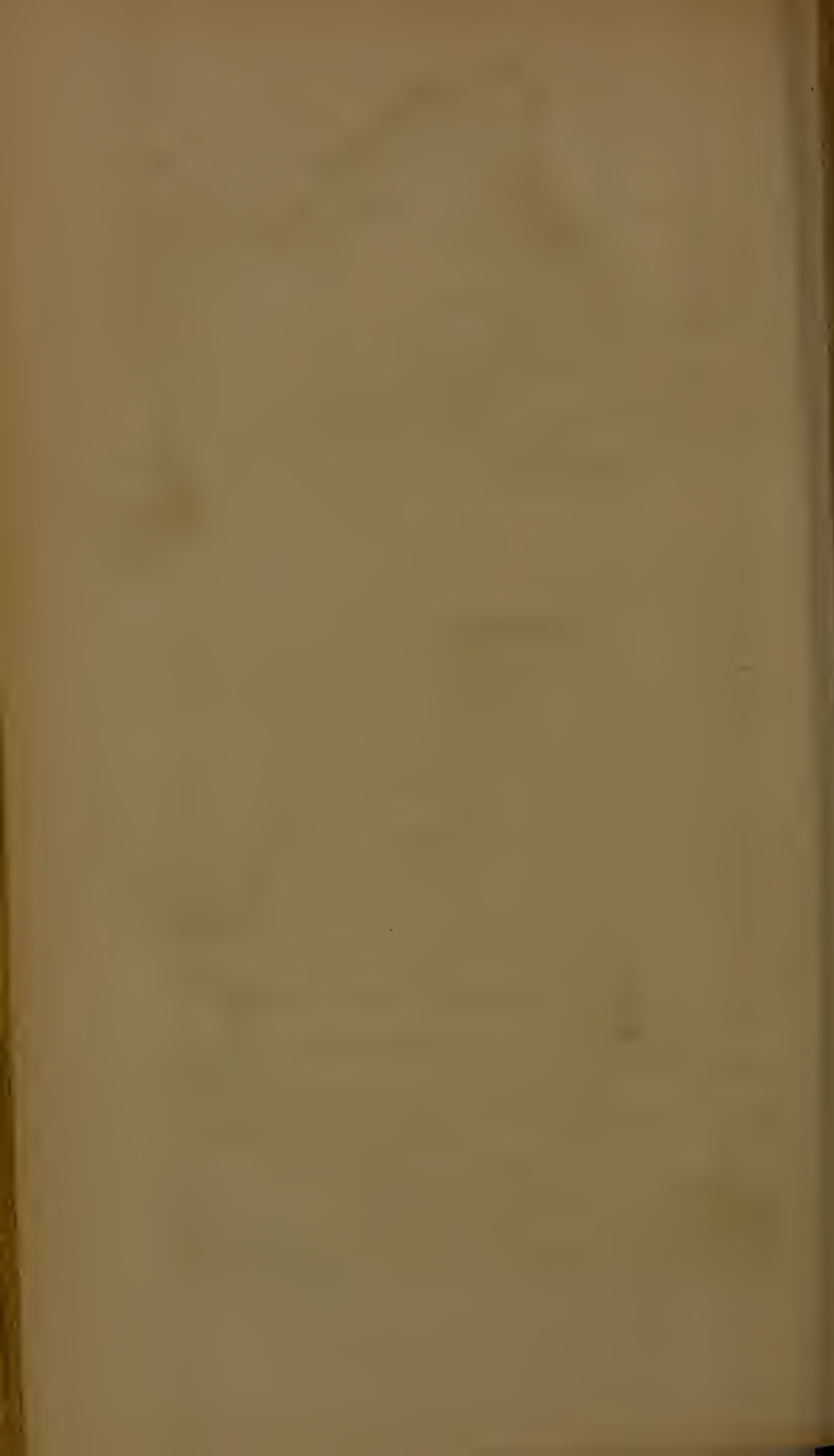


Fig. 2.





smaller caverns containing a considerable proportion of fluid.

It is perhaps worthy of remark, that though there was ulceration of the intestines, with the deposition of a few tubercles there, the bowels were slow, and even resisted the effects of laxative medicines.

CASE XXI.

PHTHISIS.

M. M., a woman, æt. 50, April 15. 1829.—Has severe cough, with profuse muco-purulent expectoration, and pain at the lower part of the sternum. Dyspnœa and palpitation on any unusual exertion. Alternate rigors and flushings, followed by sweating. Some œdema of the legs. Lies equally well on both sides, and says that her cough is worst when lying on her back. Is much emaciated. Has been subject to similar complaints for about six years, and has occasionally expectorated blood. Complaints have become much aggravated within the last two months. Breathing short and frequent. Pulse quick and soft.

21st, Distinct cavernous rale, cavernous respiration, and occasional pectoriloquy, heard between the 2d and

4th ribs, on the left side, about two inches from the sternum. Sound on percussion pretty good. Posteriorly, respiration is bronchial, on the left side of the chest. Sound of vesicular respiration obscure, with distinct sonorous, sibilous, and mucous rales, heard especially under the right clavicle, but generally over that side of the chest.

24th, Had a severe attack of diarrhœa yesterday ; gradually sank, and died late last night.

25th, *Examination*.—There were tubercles in various stages in both lungs ; farther advanced and most numerous towards the upper parts. The left lung was almost entirely a mass of disease, being in general closely studded with tubercles. Those at the upper part had broken down and formed caverns, some of which were lined with a smooth membrane ; all contained some broken down tubercular matter. The external parietes of one large cavern were very thin, and adhered to the pleura costalis at the upper part of the left side of chest, where the cavernous rale and respiration had been heard.

There were caverns in the upper part of the right lung likewise, but these were not so large, and contained more fluid matter ; they were also deeper in the substance of the lungs. The bronchi were redder than natural, and contained much muco-purulent fluid.

Remarks.—The cavernous rale, respiration, and pectoriloquy, heard so distinctly between the 2d and 4th ribs of the left side, were caused by, and indicated, the cavern mentioned as adhering so closely to the parietes of the chest. The bronchial respiration heard behind, was probably owing to the accumulation of tubercular matter there, and the vicinity of the caverns.

The catarrhal rales heard over the right side of the chest, were caused by the state of the bronchi, these having contained much mucous fluid.

CASE XXII.

PHTHISIS.

A. H., a woman, æt. 37, July 17. 1829.—Is much emaciated. Skin sallow, hot, and dry. Tongue clean. Much thirst. Bowels open. Pulse 120, soft. Appetite impaired. Sleeps pretty well. Sweats much at night. Frequent severe cough, accompanied with profuse mucopurulent curdy expectoration. Breathing quick. Occasional shooting pains in the chest. Palpitation on the slightest exertion. Lies easiest on the right side, cough being less frequent in that position.

Has been subject to slight cough and expectoration for many years, with occasional pains in the chest. Six

months ago she expectorated a considerable quantity of blood. Her complaints have become much aggravated within the last six weeks, with great emaciation.

18th, Cough and expectoration diminished. Breathing hurried. Pulse 96. Cavernous respiration, cough, rale, and pectoriloquy, distinctly heard under the right clavicle, towards its sternal extremity. Sound of vesicular respiration in lower part of right side of chest, rather faint; on left side tolerably natural.

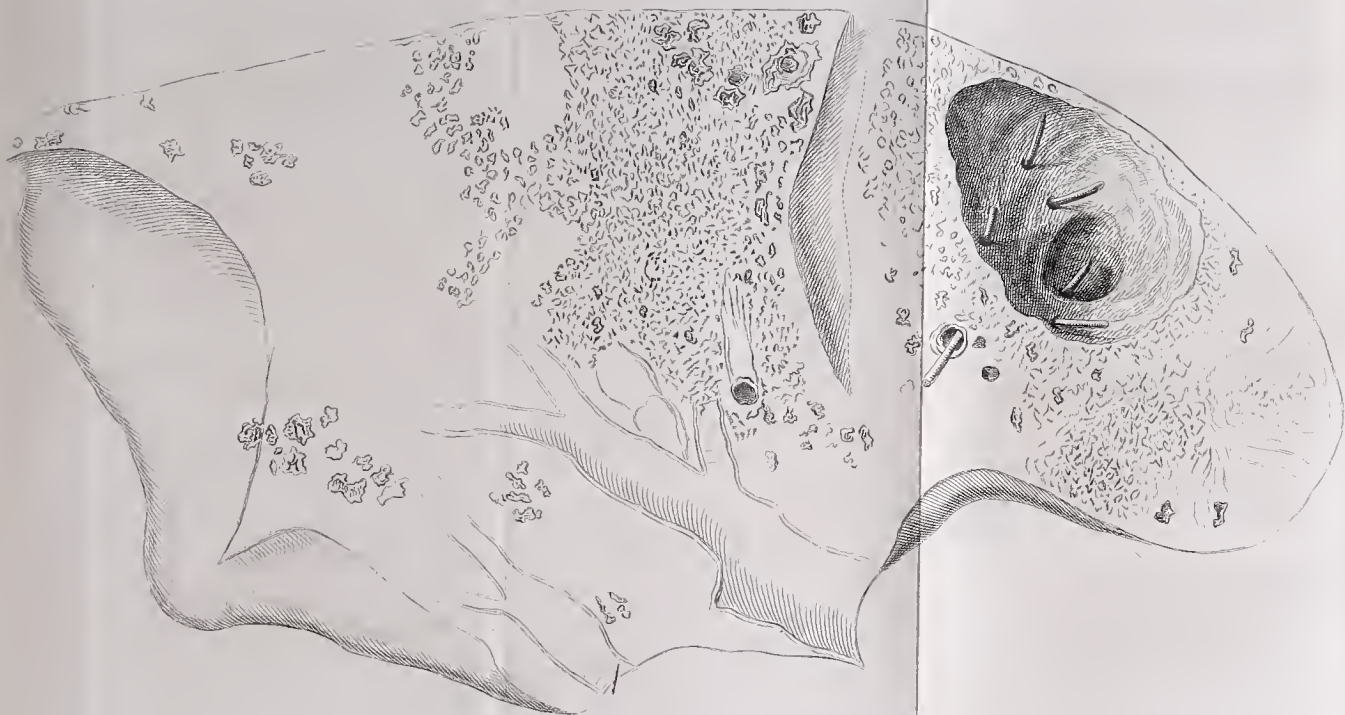
Some mucous rale, amounting to cavernous, heard under the left clavicle.

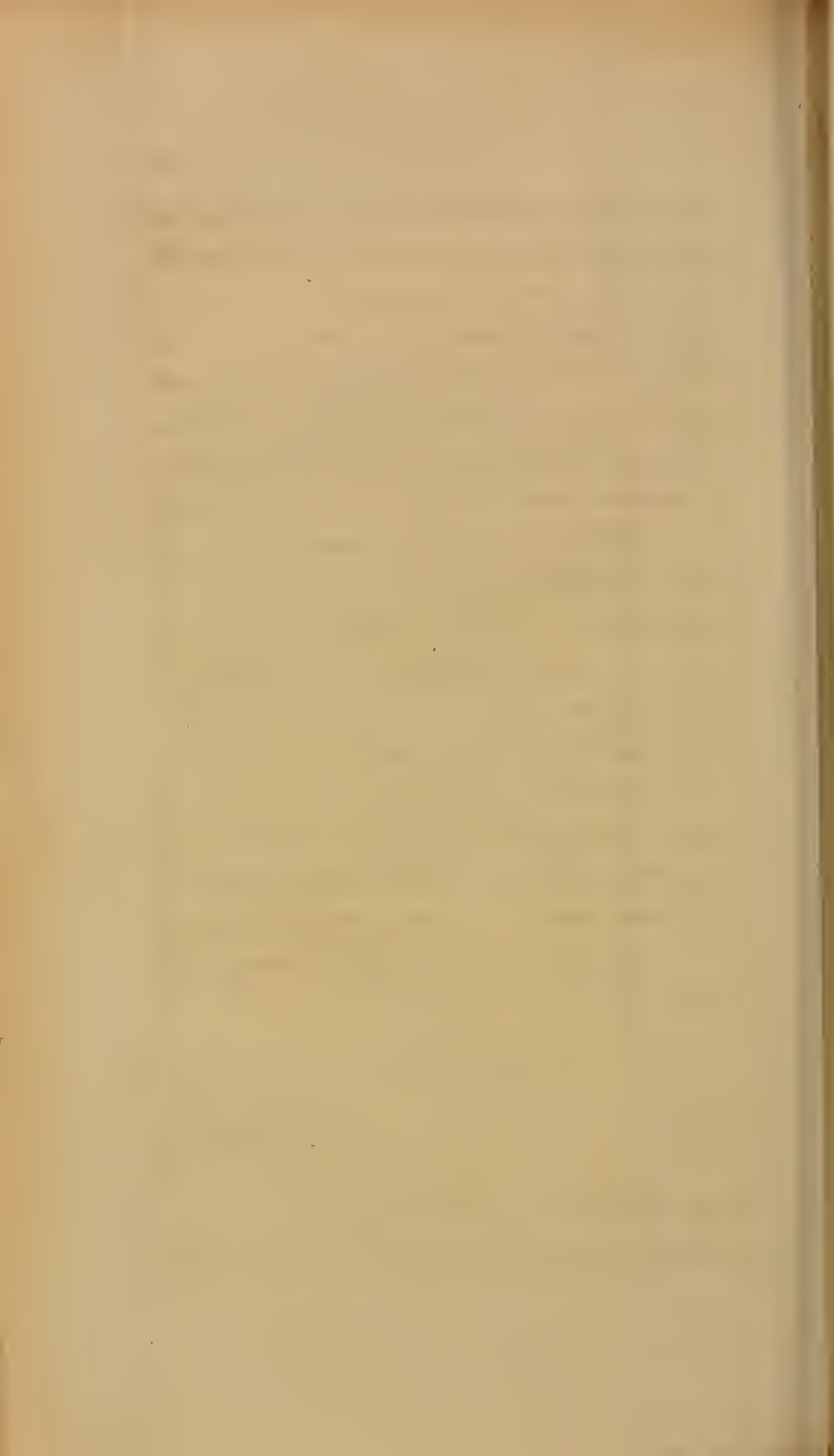
31st, Slight œdema of hands and feet. Pulse quick, and small. Breathing frequent. Cough and expectoration continue. Sweats much.

4th August, Became gradually weaker, and died yesterday evening.

A few days before her death the stethoscopical indications were as before noticed.

5th, *Examination*.—About the middle of the upper lobe of the right lung, there was a large cavity, containing a small quantity of purulent fluid (See Plate VI.) The parietes of this cavity were generally firm and semicartilaginous, with the usual soft membrane adhering to them. Here and there, however, tubercular matter projected through its walls. Nine openings, some of





which would have admitted a crow quill, were observed on the surface of the cavity, and most of them were distinctly traced to a bronchial ramification.

For the extent of several inches, the parietes of this cavity were only about one-eighth of an inch in thickness, where the cavity approached nearest to the surface of the lung. The substance of this lung nearly all around was somewhat condensed; and here and there, at other parts, small cavities were noticed containing tubercular matter. About the middle of this lung, there was an extensive deposition of semitransparent granular tubercular matter, intermixed with which there were several tubercles, further advanced, and of a yellow colour; while at some places small cavities were observed containing broken down tubercular matter. There were comparatively few tubercles in the lower part of this lung. These occurred in distinct groupes, and were much farther advanced than many much higher up the lung; many indeed were on the point of softening. This lung adhered slightly at its upper and back part to the pleura costalis.

In the left lung, there was a cavity about half the size of that in the upper part of the right, but in a similar situation, of the same structure, and nearly filled with a purulent-looking fluid. The lung around was much condensed with tubercular deposition. About the upper

part of the lower lobe there was another cavity, larger than the former, containing much softened tubercular matter, and having very ragged edges. Throughout this lung there was much tubercular matter in all stages, chiefly in the upper part of the lung, but present in patches in the lower part also. The upper and back part of the left lung adhered to the pleura costalis.

Remarks.—It is not very common to find so many signs of the existence of a cavern combined, as in this case; when this circumstance occurs, there is not more sure evidence of the existence of a cavern.

The faint sound of the vesicular respiration in the other parts of the right lung, may have been owing to the quantity of tubercular matter, which was considerable, and more profuse than in the left, where the sound of respiration was tolerably good. The cavernous rale heard under the left clavicle was caused by the cavern found in that situation.

CASE XXIII.

PHTHISIS.

J. S., a man, æt. 23, July 10. 1830.—Has frequent troublesome cough, with frothy muco-purulent expecto-

ration. Lies easiest on the right side, cough and expectoration being increased when he lies on the left. Respirations about 40 in a minute. Pulse 130, weak. Appetite good. Is affected with diarrhœa and profuse night sweating.

States that about two months ago he was exposed to wet and cold, and to this he attributes his present illness.

Does not recollect having been subject to cough before this time, except occasionally, and very slightly, during winter. Has had occasional violent pain in left side of chest, of short duration, for which he was once bled, and has had no return of it since. Never expectorated blood. Emaciation great.

11th, Cavernous rale, and cavernous respiration, with somewhat of the amphorique character, heard distinctly and loudly over almost the whole of the left side of chest, especially over its anterior and lateral portions. Imperfect pectoriloquy heard on various parts of that side.

Some cavernous rale, with bronchial respiration, heard under the right clavicle. Percussion somewhat duller over left than right side. Breathing still short and frequent. Pulse 130, small, and weak.

13th, Continued to sink, and died yesterday about 4 P. M.

Examination 45 hours after death.—The left lung adhered universally to the *plenra costalis*. A very considerable portion of this lung was occupied by tubercular excavations of various sizes (See Plate VII.)

In the middle of the lung, and close to its anterior and lateral surface, there was a large irregular cavity (*a a*), the walls of which were rough with the projection of many tubercles, but generally covered with the usual soft membrane, which, on being removed, displayed a comparatively dense surface.

The cavity communicated freely with the bronchial tubes.

At the apex, as well as in other parts of this lung, there were several smaller caverns, of different sizes, but of much the same structure as the one described.

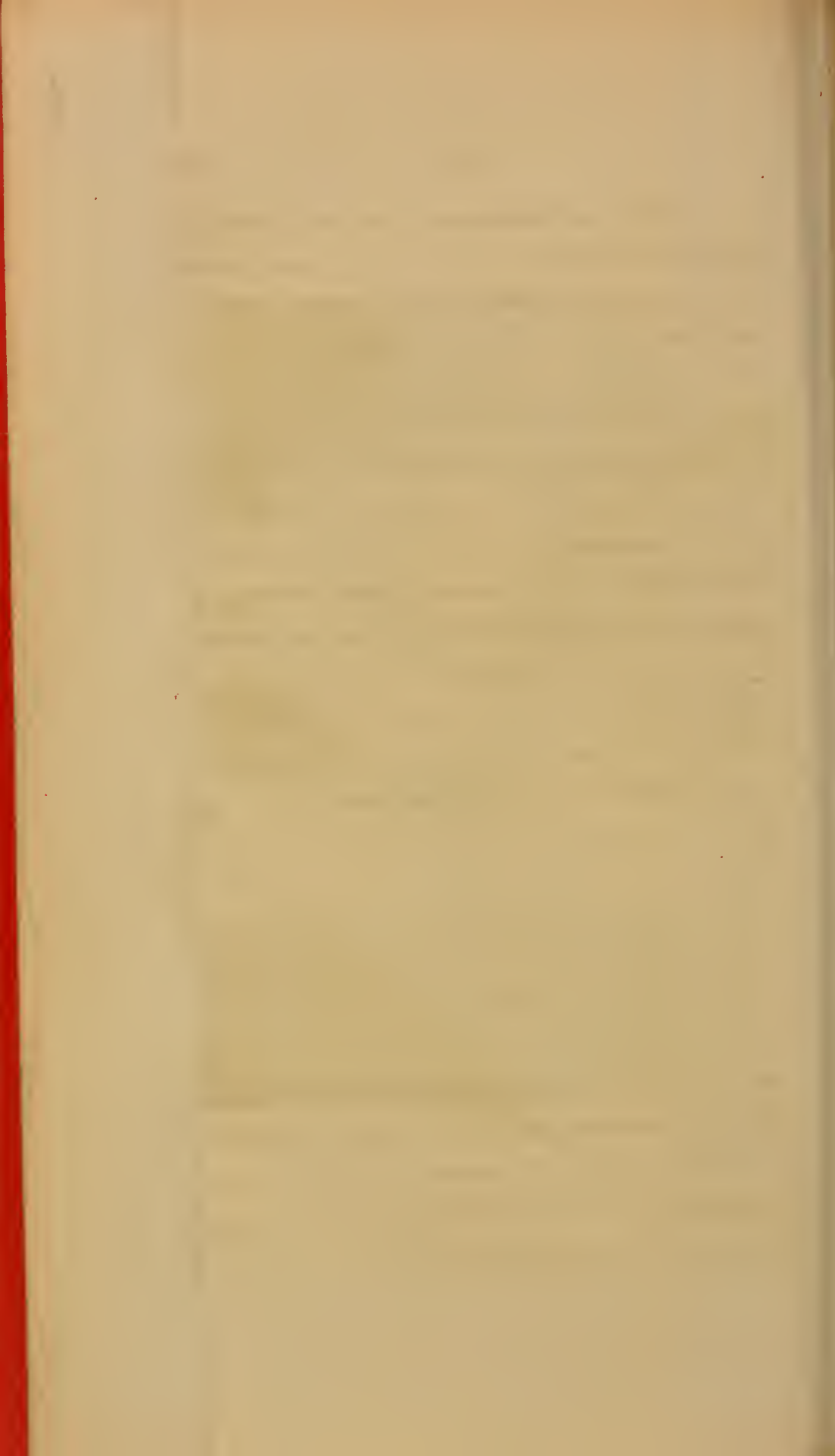
The portions of lung not occupied by the cavities contained many groupes of tubercles, in different stages.

The right lung did not adhere quite so much as the left. At its apex there were two small cavities, very like those at the apex of the left; and the rest of the pulmonary structure contained many tubercles, in different stages. This lung, however, was comparatively healthy.

The bronchial tubes in both lungs were redder than usual.

The lower part of the jejunum, the ileum, and caput cæcum coli, were examined, and found to be the site of





many tubercles, and numerous ulcerations, especially towards the lower end of ileum and caput cæcum. From the latter the mucous membrane was almost entirely ulcerated off.

Remarks.—The cavities in the left lung were indicated by the cavernous rale, respiration, and imperfect pectoriloquy heard there. The latter was probably imperfect, in consequence of the great size of the excavation.

The respiration was remarked to have somewhat of the amphorique character, which doubtless was owing to the great size of the excavation.

The bronchial respiration and cavernous rale, heard on the right side, are to be attributed to the comparatively small size of the cavities found there.

CASE XXIV.

PHTHISIS.

W. S., a man, æt. 25, January 20. 1830.—Has had cough with expectoration for five months; never had pain of chest. Cough still frequent, and expectoration mucopuriform; both much diminished of late. Some pain of throat at commencement of illness.

States that two or three months ago he could not lie on the left side, in consequence of cough and dyspnœa. He can now, however, lie easily on either side. Some weeks ago had night sweats, and some dyspnœa; these are now gone.

Expectoration is reported to have been at one time very copious, and yellow; but never mixed with blood. Tongue clean. Bowels open. Pulse 80, soft.

21st, Received a kick from a horse on the left false ribs some months ago, since which, cough and expectoration, to which he was previously subject, have increased. Sound of respiration on the left side generally, faint, and absent in some points laterally. Mucous and sibilous rales heard generally over that side. Respiration over the posterior part of right side, puerile. Some sibilous rale anteriorly. Respiration nearly natural in frequency. Pulse 88, sharp.

22d, Breathing easy; cough diminished. Pulse 100, sharp. Sound of respiration over left side generally, improved; rales as yesterday. Expectoration still copious, and partly puriform.

4th February, Rather more cough. Expectoration mixed with a little blood. Some sweating. Pulse 100, soft.

25th, Pain of the right side of chest since yesterday. Sibilous rale is still heard. Sound on percussion good.

Cavernous rale occasionally heard, especially on coughing, in the supra spinal fossa, in axilla of right side, and under clavicle. Voice weak. Amphorique respiration and cavernous rale heard under the left clavicle. Mucous and subcrepitating rales heard generally over the left side of chest. Pulse 120. Otherwise as before.

1st March, A good deal of sweating this morning; emaciation considerable. Amphorique respiration less distinctly heard under left clavicle, but cavernous respiration and rale, especially on coughing, are heard on left side of chest. Cavernous and catarrhal rales heard as formerly over the whole upper, anterior, and posterior part of right side. Pulse 120, soft. Voice continues very weak, and hoarse.

5th, Some pain referred to the larynx. Amphorique respiration continues to be heard, though less distinctly, under left clavicle.

Died on the 10th.

12th, *Examination*.—The left lung adhered, by means of its pleura, to the pleura costalis, by close firm adhesions. There were a few old adhesions at the upper part of the right lung also. Both lungs contained many tubercles.

At the upper part of the left lung, and occupying about one-fourth of this organ, there was a large tuber-

cular excavation (See Plate VIII.) Several firm condensed bands were stretched across this cavity. Its walls were of a tolerably firm texture, and here and there tubercular matter was observed projecting from them. The cavity communicated freely with the bronchi.

This cavity contained a considerable quantity of a greyish-looking fluid, apparently composed of broken down tubercular and purulent matter. There were several small caverns at the upper part of the right lung.

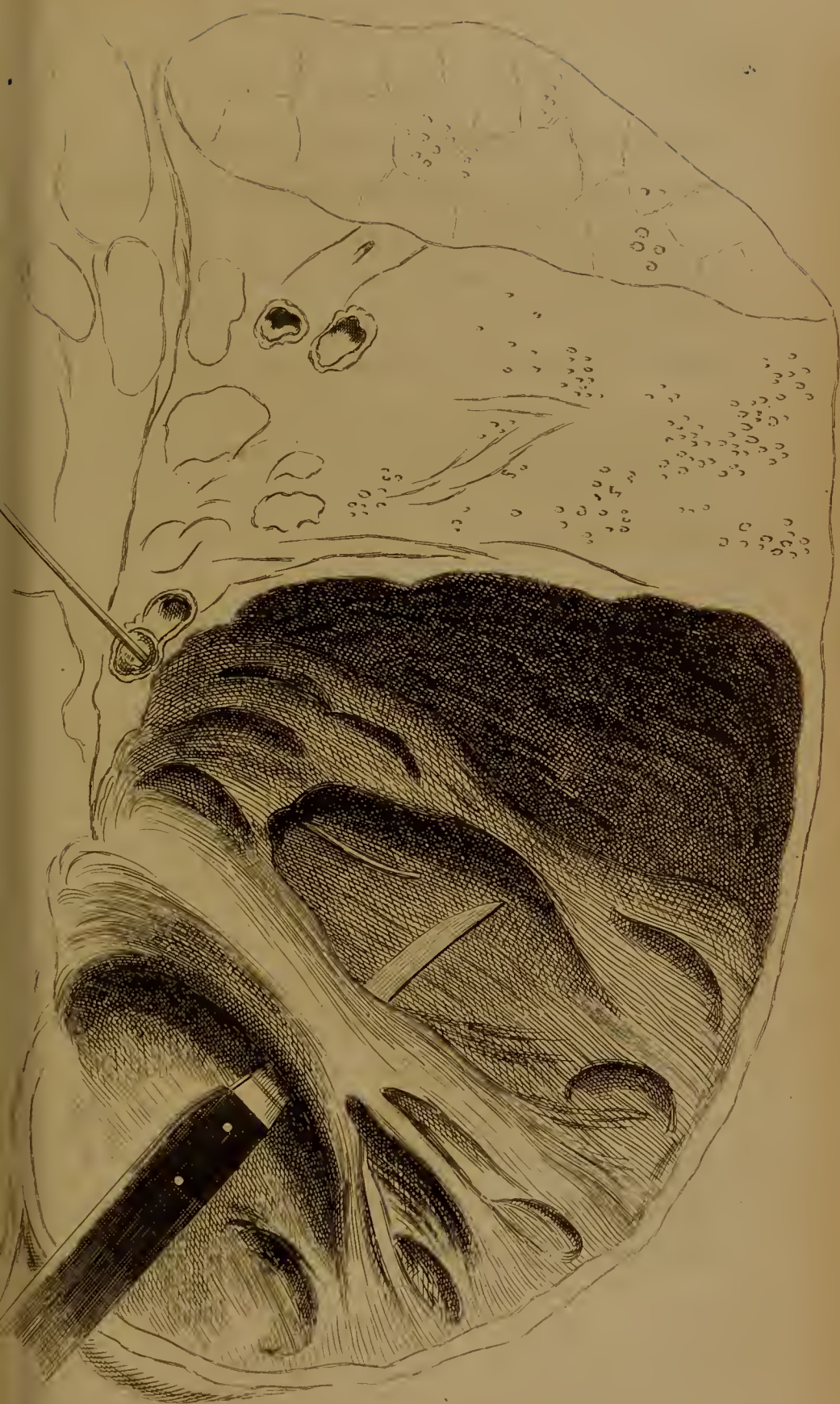
The pleura costalis, and that covering the diaphragm, had a distinct fibro-cartilaginous covering.

Remarks.—The most remarkable feature in this case is the large size of the excavation in the left lung, which was of such dimensions as to cause the development of the amphorique respiration. The cavernous rale accompanying it was owing to the fluid and air which the cavity contained.

CASE XXV.

PHTHISIS.

M. H., a woman, æt. 24, June 23. 1829.—Has severe cough, exciting pain of chest, and accompanied with co-





pious expectoration. Sleep disturbed. Night sweating. Flushing of the hands and feet. Much thirst. Bowels loose. Tongue white and tremulous. Pulse 108, small.

Is reported to have been subject to cough for about nine months. Catamenia absent last four months.

1st July, Cough frequent, and aggravated at night. No diarrhœa. Pulse frequent.

18th, Bowels rather loose. Pulse 100. Cough not so frequent. Complains of weakness.

24th, Cough very severe, causing pain of breast. Pulse 100.

31st, Pain of abdomen, and some blood passed by stool. Pain at the lower part of sternum. Pulse 104.

6th August, Cough frequent; was lately attacked with rigors. Bowels regular.

19th, Diarrhœa, with severe griping pain. Cough very frequent, and expectoration profuse, muco-purulent.

29th, Cough very troublesome; occasionally expectorates a little blood, and sometimes small masses of a black-looking matter, and chalky consistency.

3d September, Cough very troublesome; expectoration very profuse, muco-purulent and flaky. Lies principally on the right side, but some weeks before this time she lay generally on the left side. Distinet pectoriloquy and cavernous rale, with occasional cavernous respiration,

heard under the right clavicle ; respiration pretty natural below this. Cavernous rale, with imperfect pectoriloquy, heard under the left clavicle.

5th, Breathing very difficult. Much increase of the emaciation. Pulse 120, feeble. Diarrhœa and cough continue. Percussion over the anterior part of both sides of the chest good ; rather clearer on the left side than on the right, under the clavicle. Stethoscopical indications on the right side as before, and also on the left, with the addition there of amphorique respiration, which is heard over a large extent at the upper part of the right side, chiefly anteriorly. This sound is most distinct during deep inspiration.

6th, Breathing extremely difficult. Diarrhœa continues, with emaciation. Lying on back causes a sense of suffocation.

8th, Died this morning.

9th, *Examination*.—There were several firm adhesions of the lungs on both sides to the pleura costalis ; some of these, on the left side, were quite cartilaginous for the space of several inches.

About the middle of the upper lobe of the right lung there was a large cavity, with smooth, and at some places semicartilaginous, walls, lined with an irregular soft membrane, and communicating with the bronchi by se-

veral openings, capable of admitting a goose quill. The anterior aspect of this cavity was very near the surface; it was surrounded by condensed pulmonary texture, with here and there a few tubercles in different stages. There were likewise several smaller cavities, of a similar structure, in this lobe: a considerable portion of it, however, was quite healthy; and, with the exception of groupés of tubercles here and there, in different stages, and a few small cavities, the lung elsewhere was tolerably sound. There was a patch of tubercular infiltration in the lower portion of this lung.

The left lung was very much diseased (See Plate IX.). Its upper two-thirds were converted into a large irregular cavity, or, more correctly speaking perhaps, into several irregular cavities of different sizes, communicating very freely with each other and with the bronchi. These cavities were exceedingly irregular at some places, with tubercular masses projecting from their walls, and having bands of condensed pulmonary tissue running across from side to side; in general, however, they were the same in structure as that in the right lung.

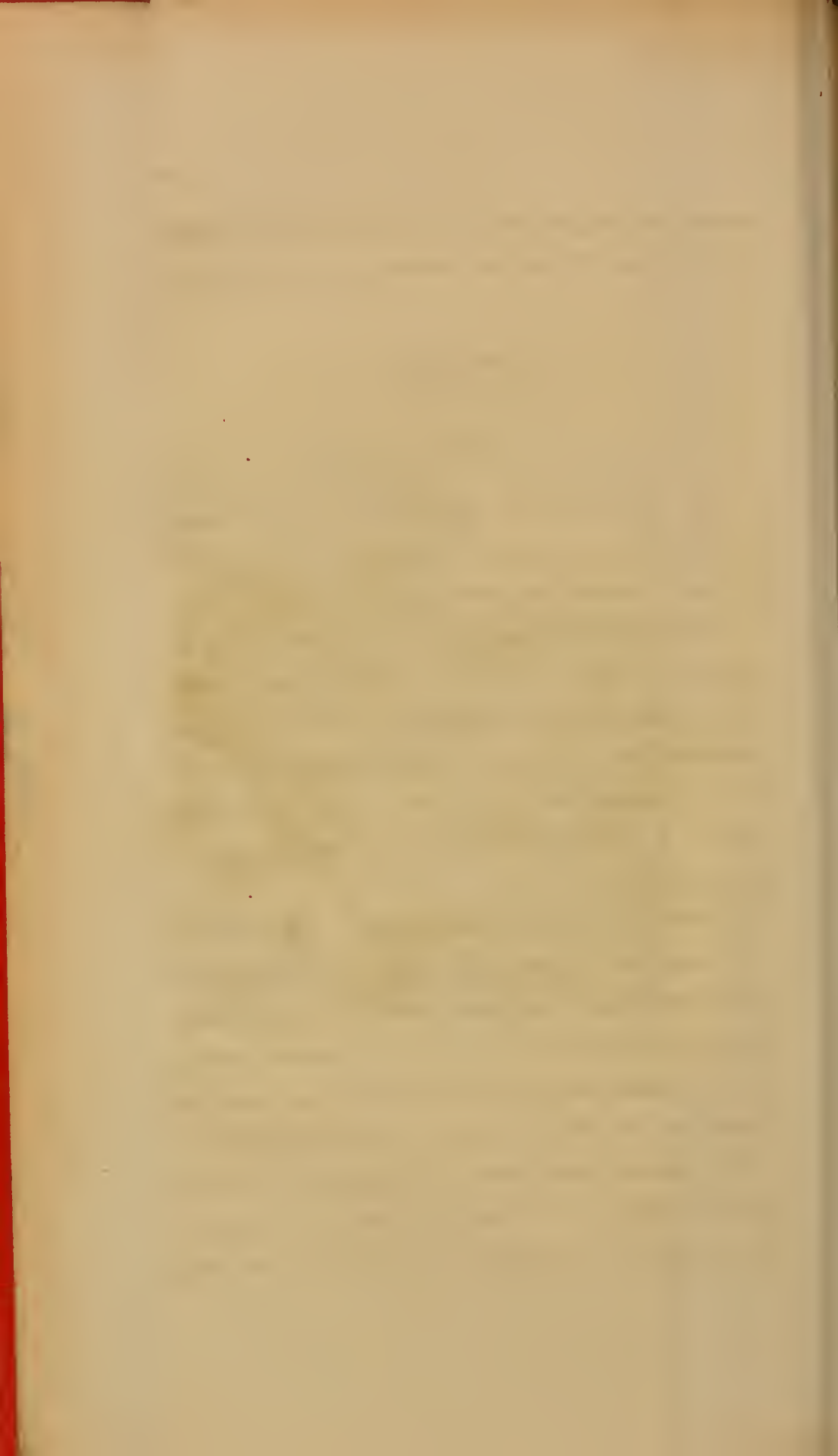
The lower third of this lung was comparatively sound; it contained, however, a considerable number of tubercles in different stages. This lung sank in water.

The only portions of the intestines examined were the caput cæcum coli, vermiform process, and extremity of

the ileum, and these presented the following appearances. On each there were several irregular ulcers, with elevated edges, which seemed to have penetrated the mucous and muscular coats. Immediately within the ileo-cæcal valve, at the extremity of the ileum, there was a very large irregular ulcer, nearly two inches in length, with elevated edges. Around the edge of this ulcer, as well as elsewhere, there were several tubercles, most of which had a yellow point in the centre. At the cæcal extremity of the vermiform process, there was another large ulcer of a similar description.

Remarks.—The distinct cavernous rale, pectoriloquy, and occasional cavernous respiration, heard in the upper part of the right lung, were caused by, and indicated, the caverns found on examination. The pectoriloquy, heard on the left side, was imperfect, probably in consequence of the great size of the cavity; while the distinct amphorique respiration was caused by, and indicated, the great extent of the excavations found on dissection. The sound on percussion was clearer on the left than on the right side; and this is to be accounted for by the presence of the large cavity mentioned, which contained little liquid, but a considerable quantity of air. The tubercular deposition in the right lung rendered the percussion there duller than on the left side, in consequence of





which the contrast between the two sides was heightened; but the left was by no means clearer than natural.

CASE XXVI.

PHTHISIS.

J. M., a man, æt. 35, August 12. 1829.—Has much cough, with expectoration. Dyspnœa. Countenance anxious. Face slightly œdematous.

Left side of chest sounds dull on percussion below the nipple, and over nearly all the posterior part. Respiration indistinct over the same extent. All the right side sounds well on percussion. The respiration generally is nearly natural there, but the sonorous rale is occasionally heard. Indistinct pectoriloquy is heard under the left clavicle.

Expectoration, muco-purulent, flaky. Has been ill for a long time. About three months ago, tolerably distinct pectoriloquy was heard under the left clavicle; and, besides the pectoriloquy, there was obscure cavernous cough, followed by a sound of fluctuation under the left clavicle; at that time he lay chiefly on the left side.

Was attacked about five weeks ago with diarrhœa, and occasional rigors, followed by flushing and sweating. Has become much emaciated. Is reported to have been

subject to cough and occasional diarrhœa for nearly two years, with copious expectoration; and, eight months ago, had pain of the left side. Has had frequent palpitation. Has been much exposed to cold and wet, and has lived intemperately. Never expectorated any blood.

20th, Expectoration mucopurulent. Emaciation advances. Pulse weak.

22d, Languor and debility increase. Pulse 90, feeble.

26th, Continued to sink, and died last night.

A few days previous to his death, indistinct pectoriloquy, with cavernous rale, were heard under the right clavicle; but his voice was at that time extremely weak.

27th, *Examination*.—There were a few firm adhesions at the upper part of the right lung. This lung was perhaps more voluminous than usual. About the middle of its upper lobe, there was a cavity containing some purulent fluid; it communicated with the bronchi by several openings. Its parietes were formed of a dense cartilaginous structure, which was lined with a soft lymphic membrane. The external parietes of this cavity, corresponding to the place where pectoriloquy was heard, were about one-eighth of an inch in thickness. A large pulmonary vessel was exposed for a considerable extent on the surface of this cavity. Close to the cavity mentioned, there was an evident cicatrix of some old tuber-

cular excavation. Externally, at this place, the lung was drawn inwards, causing an indentation on its surface. On cutting into this part, two cartilaginous bands were distinctly seen, which probably had at one time formed the walls of the excavation.

There were a few tubercles, in various stages, in the upper lobe of the right lung also, but very few in the lower part; indeed a very large portion of this lung was quite healthy.

The bronchi were redder than natural, and contained much mucus.

The left lung was much diminished in size, and converted into one large irregular cavity (See Plate X. Fig. 1.), containing air, much muco-purulent fluid, broken down tubercular matter, and several loose earthy concretions (*bb*). Many firm bands were stretched across this cavity, chiefly from the parietes to the centre. Its walls were generally firm, and of a structure similar to those in the cavity of the right lung, with here and there rounded projections of tubercular matter. At many places the walls of this cavity were hollowed out into smaller excavations, which freely communicated with each other, and with the common cavity. There were an unusual number of communications with the bronchi throughout this extensive excavation. Very little of the pulmonary texture of this lung was permeable to the air,

being almost entirely condensed, and unfit for the performance of its function. This cavity, or, in other words, the compressed and excavated lung, adhered firmly on all sides to the pleura costalis and mediastinum. The trachea and bronchi were in this case very large, being, especially in the left lung, about twice the usual size, and, in the same lung, much redder than usual.

The great left branch of the pulmonary artery was completely blocked up by an oblong fibrinous mass (Fig. 2.) On the side of this there was a small opening, leading into the interior of the mass, which itself was found to be filled with purulent matter, of a greenish hue, similar to that in the large cavity. Its parietes were thin, and rather rough internally, but very smooth externally. Many smaller branches of this vessel were obliterated. At the extremity of a pretty large one, and projecting into the large cavity in the left lung, an irregular fibrinous body was found plugging up the extremity of the vessel (Fig. 1. & 3. *a*). None were found to open into the cavity.

The mucous membrane of the large intestines, and the lower part of the ileum, were ulcerated here and there. At the lower part of the ileum, there were many small yellowish, elevated, tubercular-looking spots, intermixed with small ulcerations. The intestines were more diseased at the lower end of the ileum, and at the caput cæ-

PLATE X.

Fig. 1.



Fig. 3.



Fig. 2.



eum coli, than elsewhere, as appears to be most usually the case.

Remarks.—The dull sound on percussion, and indistinctness of vesicular respiration, indicated a morbid state of the left side of the chest, while the obscure pectoriloquy and cavernous cough, followed by a sound of fluctuation, heard under the left clavicle, indicated the existence of a large excavation on that side, containing air and liquid.

The pectoriloquy was probably obscure, in consequence of the extent of the excavation, together with the weakness of voice.

Pectoriloquy and cavernous rale heard under the right clavicle, were proved to have been owing to the existence of a cavern in that situation; the pectoriloquy was indistinct, probably in consequence of the great weakness of his voice at the time. The otherwise comparatively sound state of this lung was indicated by the signs mentioned, namely, natural sounds on percussion and during respiration. The mucus in the bronchi, and the state of the mucous membrane of these, may account for the sonorous rale occasionally heard.

The fibrinous plugs mentioned are comparatively rare, and shew beautifully the efforts of nature in repairing injuries in the living body, or at least in preventing the otherwise immediately fatal effects of such.

CASE XXVII.

PNEUMOTHORAX.

G. M., a man, æt. 25, November 20. 1829.—Has much cough, with profuse expectoration of a frothy mucopurulent matter. Cough and deep inspiration excite a dull pain at the anterior and lower part of the right side of thorax, and in the right hypochondrium, where pressure likewise causes pain. Respirations 32, performed with little movement of thorax. Pulse 114, small and sharp. Skin hot. Tongue florid, moist. Thirst. Appetite impaired. Sweats at night.

States that cough and expectoration began about six months ago, after exposure to cold, during convalescence from measles, and was attended with much expectoration of blood.

About six months ago had a sudden attack of increased difficulty of breathing, with pain across the upper part of chest, which continued for a considerable time. A few days ago was attacked with the present pains; which have since abated a little in severity. The right side of chest appears rather fuller, and moves less on respiration than the left.

26th, More dyspnoea in the night, and sweating this

morning. No return of pain of the side. Pulse very frequent and soft. Skin rather cool. Less expectoration.

27th, Breathing continues difficult, and he cannot lie down. Cough still frequent; rather more expectoration. Pulse small and frequent.

28th, Dyspnoea and cough urgent during the night; less expectoration. Breathing easier this morning.

30th, Yesterday evening pulse was about 90. Breathing not more difficult, but it became worse in the night, without increase of cough; and he died at seven this morning.

A few days before death the following was the state of the chest, by percussion and auscultation. The amphoric respiration was heard over a space extending about three or four inches around the right nipple, and the sound, on percussion there, was tympanitic; but below, laterally and posteriorly, the sound was quite dull on percussion. The vesicular respiration was absent all over this side of the chest, but the bronchial was present in the region corresponding to the root of the lung posteriorly. The sound, on percussion over the left side, was comparatively natural, and the puerile vesicular respiration was generally heard over that side. Fluctuation was observed in this case, on succussion, in the right side, both before and after death.

Dec. 2. *Examination.*—The right side of the chest was found to contain about twenty ounces of purulent matter, and some air, which was heard to escape in part, when the cavity was opened, and this corresponded to the place where the amphorique respiration was heard. The pleura pulmonalis and costalis were covered with a dense, thick layer of lymph. At the upper part of the cavity there was an irregularly rounded opening through the layer of lymph and surface of lung, having much the appearance of a small tubercular cavern, which had burst into the cavity of the pleura. Through an opening in the centre it communicated with a small cavity, evidently tubercular, and, by another opening, it communicated by a tortuous course, with the bronchi.

The cavity or aperture mentioned was not very deep, but might easily have admitted the extremity of the forefinger or thumb. (See Plate XI. Fig. 1. *a*.)

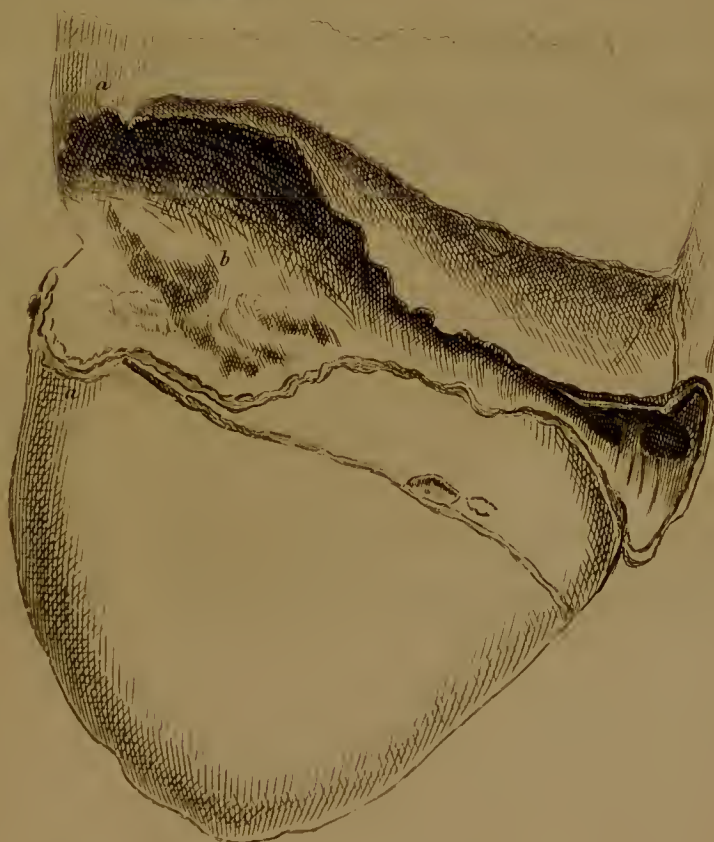
Both lungs contained much tubercular matter in various stages.

Remarks.—The clear sound, on percussio around the right nipple, indicated the existence of air, while the dull sound below, laterally and posteriorly to this, denoted the presence of something morbid, which in this case was proved, by the succussion, to have been fluid along with air. The amphorique respiration proved the existence

Fig . 1 .



Fig . 2 .





of an opening, communicating with the cavity containing the air, and the bronchi. The metallic resonance was absent, probably in consequence of the smallness of the cavity containing the air, which was much less than is usual in pneumothorax, and unable to yield sufficient resonance to cause its development.

There was bronchial respiration about the root of the lung of the right side, in consequence of this lung being pressed against the mediastinum, so that the vesicular structure could not be expanded, and, in fact, bronchial respiration only could take place.

The puerile vesicular respiration heard in the left lung, indicated its increased action and comparative soundness, though, at the same time, it contained many tubercles.

The right lung contained so much tubercular matter, that it could not be much reduced in size by the liquid and aëriform effusion; so that, though the quantity of fluid was small, the space occupied by the air was also small.

CASE XXVIII.

PNEUMOTHORAX.

J. M., a woman, æt. 22, unmarried, Feb. 28. 1830.—
Respiration hurried; chiefly abdominal, and about 40 in

a minute. Complains of severe pain in the right inferior lateral region of chest, and under the mamma, occasionally darting across to the left side; increased by coughing, pressure, and full inspiration. Has a short, dry, cough, occurring in paroxysms, with scanty tenacious mucous expectoration. Anteriorly the chest is sufficiently resonant on percussion, and, in the painful portion, it affords a hollow and tympanitic sound. The respiratory murmur is loud over the left side of the chest, mixed with mucous and suberepitating rales. In the inferior lateral portion of the right side of chest the metallic resonance is heard.

Her extremities are cold; and has total loss of appetite, with nausea. Bowels open. Tongue furred, white. Pulse small, and indistinct. States that the present is the first pectoral affection from which she has ever suffered, and ascribes it to exposure to cold. Three weeks ago, after a fatiguing journey, she first experienced pain in the side, with cough. The pain, which was first felt immediately under the right mamma, after a short time, extended itself lower down, and the cough became gradually worse, with difficult respiration; all the symptoms progressively increased until the 25th, when she for the first time had recourse to medical advice, and was bled largely; since which the pain has been rather less acute, but more permanently fixed in the situation described.

The expectoration, which, at the commencement of her illness, was very scanty, has rather increased within the last few days ; it has never been tinged with blood.

1st March, Pain unmitigated ; lies always on the right side. Respirations 44, laborious. Expectoration very scanty, transparent, tenacious. Action of heart jarring, and the apex distinctly felt between the 6th and 7th ribs. Pulse 140, small. Right lateral portion of chest, while she is lying horizontally, is remarkably sonorous on percussion, but becomes quite dull when she sits up. Towards evening she became quite exhausted ; surface and extremities cold ; breathing more laborious ; and she died next morning.

The right side of chest was more prominent than usual.

3d, *Examination*.—In the right cavity of the pleura were about five pounds of sero-purulent fluid, containing many flakes of lymph, and much albuminous effusion ; there was likewise a considerable quantity of air, corresponding to the tympanitic portion of chest. The pleura costalis and pulmonalis were universally coated with recent lymph, which was easily separated at some places, exposing an organized irregular vascular layer beneath, the result of some former pleuritic inflammation.

The right lung was compressed into a very small bulk,

and lay against the spine and mediastinum, firmly bound down by the effusion of lymph. At the distance of nearly one-third from the apex of the lung posteriorly, there was an opening into it about a quarter of an inch in diameter, and with ragged edges (See Plate XI. Fig. 2. *aa*). This, on examination, was found to lead into a considerable cavity, having the appearance of a tubercular excavation, with irregular parietes, and communicating freely with the bronchi, particularly by one large branch (Fig. 2. *b*). In various parts of this lung, the substance of which generally was healthy, though condensed and containing no air, there were several rounded tubercular masses of different sizes, having exactly the same structure as some of the irregular masses on the walls of the cavity mentioned.

The left lung adhered by means of its pleura to the pleura costalis, and generally presented the effects of inflammation, being in several places in the first stage of hepatization, and otherwise in a state of sero-sanguinolent infiltration.

Remarks.—The loud sound on percussion, and presence of the metallic resonance, proved the existence of the pneumothorax. The change of sound on percussion, by change of posture of the trunk, indicated the presence of fluid. The subcrepitating rale, in this case, existed along with, and is to be attributed to, the inflammation of the

left lung, which the examination proved to have existed.

CASE XXIX.

PNEUMOTHORAX.

S. F., a man, æt. 39, April 8. 1830.—Has frequent cough, with, in general, a moderate expectoration of muco-purulent appearance. When he lies upon his right side, which he can do without uneasiness, his expectoration becomes very copious. To avoid the inconvenience of this he lies upon his left side, except for a few minutes in the morning and evening, at which times he turns to his right, and with frequent coughing discharges a large quantity of muco-purulent matter. For some time previous to this evacuation, his breathing becomes difficult, and it is relieved by the discharge mentioned. Some dyspnoea, however, is always present, although not to a great degree. A loud splashing or fluctuating sound is produced by succussion of the trunk, and there is a marked dulness on percussion at the lower part of left side of chest, when he is in the erect posture.

When the body is bent forwards, and percussion made in front, about the 6th rib, the sound is dull and flat ;

when, however, the body is reclined backwards, the sound produced is loud and resounding; more so than that of the opposite side, which, however, gives almost the natural sound on percussion.

On application of the stethoscope to those parts of the left side of chest where the sound of percussion is clear, the amphorique respiration and metallic resonance are very distinct, particularly at the anterior part of chest, from the 3d to the 6th rib.

The "metallic tinkling" is also audible at intervals, without effort on his part.

There is general pain over the left side of chest.

On the opposite side of the chest, respiration is louder than natural at the lower part, but is not otherwise different from a state of health; above, percussion is somewhat dull, with mucous rale.

The action of the heart is perceived to the right of its natural position.

Perspires at times, but not profusely. Bowels natural. Respirations 30 in a minute. Pulse 100, of moderate strength. Is much emaciated.

States that about five months ago he was exposed to cold and wet. The day after this he became affected with severe pain over the left side of chest, with cough and expectoration of a bluish appearance, and viscid. Two or three days after this attack he was sensible of

what he called "a gurgling sound," proceeding from the left side of his chest upon changing the position of his body. At this time, when he lay upon his right side, he had a feeling of a weight in his chest, as of a heavy body from the left side pressing down upon the right, and rendering his breathing difficult. He continued in this state for about three months; at the end of this period he suddenly, and for the first time, expectorated in large quantity a matter of similar appearance to that which he at present discharges. During the two months which have elapsed since, he has continued sensible of the sound of fluctuation in the chest, which he at one time compared to that produced by a flask containing some water.

His breathing, he says, has been short from childhood, but that previous to the period at which the present affection commenced, he had no fixed pain of chest. States also that his mother had been subject to asthmatic complaints.

10th, Stethoscopic signs as before. Diarrhœa during the night. Sweating profuse.

11th, Diarrhœa continues. Perspires profusely. Legs are considerably swollen.

18th, Although the symptoms mentioned above had continued with little remission, he passed a good night,

but his breathing became difficult towards morning, and he died about 8 o'clock A. M.

He had occasionally complained for some days before his death of pain in the abdomen, but did not mention it as being very severe *.

19th, *Examination*.—The heart and its appendages were found somewhat to the right of their natural position, being chiefly behind the sternum, projecting, however, a little to its right side.

The left lung was compresssd against, and adhered to, the mediastinum and spine. There was likewise a slight adhesion to the costal parietes anteriorly.

The pleura investing the lung, and likewise the pleura costalis, were covered over by an irregular and flocculent integument of lymph, which adhered with tolerable firmness at some parts, while at others it was softer, easily removed, and decidedly more recent.

Through the layer of lymph, and pleura, there were several openings into the lung. The two uppermost communicated with a cavity about the size of a walnut, toward the apex of the lung, which itself communicated freely with the bronchi (See Plate XII. *a*).

* We are indebted to our friend Mr HENDERSON of the Royal Infirmary for the previous history of this case.





Other two openings, farther down the lung, communicated directly with the bronchi (*b*).

This lung, on being cut into, was found of a fleshy consistency, and was without crepitation.

Both lungs contained tubercular matter, chiefly in the miliary form, in different stages; and it has already been mentioned that there was a tubercular cavity in the upper part of the left. This was not the case with the right, however; but the tubercular matter in it was here and there softened, and in progress to the formation of small caverns. The right lung was otherwise quite natural.

In the left cavity of the pleura there were about four pounds of purulent matter; the remainder of the cavity, which was considerable, being occupied by air.

Remarks.—In this case, the sound on succussion, and metallic tinkling, were indications of the existence of liquid and air in the chest, which the examination proved to have been present. The existence of the former was farther proved by the alteration of the sound produced by percussion on change of position; and the latter by the presence of the metallic resonance.

The amphorique respiration was consequent upon, and proved the existence of communication with the bronchi.

CASE XXX.

PNEUMOTHORAX.

P. B., a man, æt. 35, August 21. 1829.—Has been subject to cough, expectoration, and dyspnœa for a considerable time. Was a few weeks ago seized with severe pain at the lower part of the left side of the chest, accompanied with increased difficulty of breathing, and has generally lain upon that side since. Skin hot. Pulse 120, full and strong. Still complains of pain at the lower part of the left side of the chest, and this side is protruded, the ribs being more distant from each other than usual. The left side of chest is, besides, generally tympanitic on percussion, but particularly so at its upper part. Vesicular respiration inaudible. Metallic resonance is very distinctly heard after coughing or speaking. Vesicular puerile respiration heard in the greater part of the right side, and percussion is duller there than on left side, but apparently natural. Much cough, with profuse muco-purulent expectoration. Breathing quick.

26th, Still complains of pain in the left side of chest, chiefly at the lower part. Metallic resonance not so distinct to day. Expectorated some blood yesterday.

29th, Expectoration very profuse. Breathing hurried.

Face flushed. Pulse 120, full, sharp. Still complains of pain at the lower part of the chest. Metallic tinkling occasionally heard, without any effort on his part, and the metallic resonance distinct after speaking and coughing, over the whole of the upper part of the left side of chest, anteriorly in particular. Vesicular respiration heard near the spine, about the inferior angle of scapula. Puerile vesicular respiration heard over the right side. Left side of chest is little raised on inspiration, when compared with the right, but still it moves. Action of the heart perceived by the stethoscope more to the right than to the left side of the sternum.

September 5th, Metallic resonance distinctly heard over a large space on the left back, after every syllable while speaking; most, however, on coughing. Slight amphoric respiration is also occasionally heard. Vesicular respiration still heard along the spine on left side. Puerile in the other lung. Left side generally sounds clear, but not quite so tympanic as before, though still so at some places. Pain has much abated, and the left side of chest moves during respiration more than formerly, and apparently before the right. Expectoration still profuse. Sweats much. Lies always on the affected side. Pulse frequent. More emaciation. Is free from pain; and his breathing is not so hurried as formerly.

8th, Feels somewhat easier. Metallic resonance distinct at the inferior angle of left scapula. Pulse frequent. Skin hot. Breathing quick.

11th, Died last night.

No examination allowed.

Remarks.—Although in this case no examination was permitted, there can be no hesitation in pronouncing it to have been a case of pneumothorax, with the presence of a liquid in the chest at the same time; and the stethoscopical signs warrant the diagnosis.

The sound, on percussion, was louder than natural, while the sound of vesicular respiration was absent generally over the left side of chest, indicating a morbid state of the parts. Amphorique respiration was heard, indicating the existence of a communication with the external air, by the bronchi. The metallic resonance was present after coughing and speaking, indicating the existence of a large cavity containing air; while the metallic tinkling, occurring without these efforts, indicated the existence of liquid besides; which, we have no doubt, was purulent matter.

The action of the heart being heard more to the right than usual, indicated the existence of something morbid in the left side, pressing this organ to the right side of the chest.

CASE XXXI.

PNEUMOTHORAX.

G. I., a man, æt. 38, July 27. 1830.—Has a troublesome cough, which is usually worse during the night, but he has no pain in the chest, except at times when the cough is very severe. Expectoration scanty and mucopurulent. He can lie on either side, but says he is easiest when lying on the right. Complains of general weakness, and perspires profusely during the night. Bowels in general rather slow. Tongue white. Appetite impaired. Great thirst. Pulse 120. Skin hot. Emaciation considerable.

Reports that his complaints commenced about six weeks ago, after exposure to cold and wet.

28th, Sound of vesicular respiration heard, generally faint, over both sides of the chest. Sound on percussion good.

August 7th, Yesterday he suddenly became affected with severe pain in the left shoulder, and extending down that side of chest, accompanied with difficulty of breathing.

21st, Percussion over the anterior part of left side of

chest, when lying in bed, louder than over the right side ; and metallie resonance is heard there.

23d, Metallie resonance heard, after coughing, over nearly the whole of the left side, anteriorly and laterally, from 1st to 11th rib. Amphorique respiration is likewise heard in the same situation. Succussion of the chest produces a distinct sound of fluctuation. The left side of the chest is much protruded, and the intercostal spaces are widened. Percussion over this side of chest produces a tympanitic sound, even to a low point, when he is sitting up.

Slight tapping upon the chest produces metallie resonance, which is distinctly audible on the application of the stethoscope.

Respiration frequent, but he experiences very little uneasiness. Pulse frequent and soft.

24th, Metallie tinkling heard occasionally on left side of chest, without any effort on his part. Metallic resonance heard as before, after coughing, and, for the most part, after every word or syllable he utters.

Action of the heart cannot be felt by the hand, but is distinctly heard between cartilages of the 3d and 4th ribs on right side.

Sound of respiration heard over right side rather puerile. Cough not very troublesome ; expectoration mucopurulent. Pulse 112, small and soft. Skin hot. Lies

occasionally on the left side, but prefers lying on the right, which he most usually does. Emaciation increasing.

30th, Febrile symptoms abated. Pulse 92, soft. Respirations 24 in a minute. Cough less. Still prefers lying on the right side. Has occasional paroxysms of dyspnoea. Metallic resonance and amphorique respiration as before. States that a few days ago he heard a "ringing sound" in his chest, after moving himself.

September 5th, Has been daily becoming more emaciated and feeble. Metallic resonance heard to-day as before.

6th, Died about 2 P. M.

8th, *Examination*.—Left side of chest still much protruded, and tympanitic on percussion. Metallic resonance is easily produced, by tapping smartly with the fingers on the sternum; and it is distinctly heard by the application of the stethoscope to the left side of the chest at the same time. Succussion elicits the sound of fluctuation; and the sound produced by percussion is altered by change of position.

On puncturing the anterior part of the left side of the chest, air was perceived to issue; and, on opening the chest, a large space was found occupied by air, corresponding to the part which had elicited the clear sound on percussion.

There were likewise about four pounds of sero-purulent fluid, containing many portions of coagulated lymph in the left side of the chest. The pleura costalis was coated over with a regular soft, slightly adherent, layer of lymph.

The left lung was compressed to a small bulk, and lay close to the mediastinum and spine, but, except at the upper and back part, it did not adhere very firmly. The pleura pulmonalis was very slightly coated with lymph.

At the apex of the lung there was an irregular opening, capable of admitting the point of the finger. This orifice was found to communicate with a large irregular tubercular cavity, which communicated with the bronchial tubes.

The lung contained tubercular matter, in different stages, and was generally in the usual state of carnification which compressed pulmonary tissue is found to assume.

The heart and its appendages lay much to the right of their natural situation. The valves of the left side of the heart were slightly diseased.

The right lung was somewhat emphysematous, and contained a few groupes of tubercles in different stages, but there were no excavations in this lung.

Remarks.—It is probable that in this case the pneumo-

thorax took place on August 7th, but it was not proved until percussion and auscultation had been made use of on the 21st. The metallic resonance heard after coughing and speaking proved the presence of air in the chest. The metallic tinkling, occurring without any effort, was probably caused by the bursting of a considerable air-bell, so that this, as well as the succussion, proved the existence of air and liquid in the chest.

The amphorique respiration indicated the existence of a communication with the bronchial tubes.

The respiration was rather puerile in the right lung, and it was found only to contain a few tubercles.

The site of the heart accorded with the place where its action had been heard during life.

In this case the metallic resonance was produced equally by percussion on the chest during life as after death; proving distinctly, that this phenomenon is dependent upon the resonance which takes place in any considerable cavity containing air.

CASE XXXII.

DISEASE OF THE SEMILUNAR VALVES OF THE AORTA.

M. M., a woman, æt. 55, July 13. 1829.—Has occasional cough, with scanty expectoration. Pulse 116,

small and sharp. Impulse of heart somewhat stronger than natural, with distinct *bruit de soufflet*, heard most distinctly between the 5th and 7th ribs, and at the lower part of the sternum, forming the first sound of the heart's action. Breathing quick. General œdema. Urine scanty. Dyspnœa and palpitation, especially on any unusual exertion, and has occasionally, for several years back, been affected with these, accompanied with slight œdema of legs; but her complaints have become much aggravated during the last five or six weeks. Complexion sallow.

15th, Gradually sank, and died about 2 A. M.

16th, *Examination*.—There were about eighteen ounces of clear serum in each side of the chest; four ounces in the pericardium. Lungs contained much serum.

There was slight hypertrophy of the walls of the left ventricle. The ventricular surface of the larger segment of the mitral valve, had several yellowish cartilaginous patches here and there. The auricular surface was not at all affected.

The sigmoid valves of the aorta were thickened, corrugated, and partly cartilaginous, particularly at their bases, and towards their floating edges. On the aortic surface of one of them there was a considerable earthy concretion (See Plate XIII. Fig. 1. *a*). The inner surface of the aorta, in a line immediately above the sigmoid

Fig. 1.



Fig. 2.





valves, and around the mouths of the coronary arteries, presented a number of slightly elevated cartilaginous spots; also here and there projecting through the inner membrane, there were scales of an earthy character. Where the aorta begins to descend, there was a considerable patch of a similar disease: and indeed the arterial system, so far as examined, was generally affected. Several of the intercostal arteries were obliterated by fibrinous matter.

The heart otherwise seemed natural.

Remarks.—The strong impulse of the heart was an indication of the thickening of the walls of one or other of the ventricles; in this case the left, as is most usual, but it was not to any great extent here.

The *bruit de soufflet* was probably caused by the contraction of the aortic opening of the left ventricle, consequent upon the presence of the disease of the sigmoid valves.

CASE XXXIII.

HYPERTROPHY AND DILATATION OF THE LEFT VENTRICLE, WITH DISEASE OF THE MITRAL AND SEMILUNAR VALVES OF THE AORTA.

J. M., a woman, æt. 48, June 20. 1829.—Has œdema of face and lower extremities. Breathing short, and somewhat laborious. Thirst. Urine scanty and high coloured. Frequent cough. Pulse 74, full, and hard. Complexion sallow. Reports that the dyspnœa and œdema have been present for about ten days.

24th, Pulse full, and firm. Urine more copious.

25th, Face still œdematous.

3d July, Some dyspnœa yesterday. Urine sufficient in quantity. Pulse hard, and jarring.

15th, Œdema continues. Pulse as before.

25th, Occasional severe and rather long paroxysms of dyspnœa.

26th, Percussion on the lower part of the right side of chest dull, and the sound of respiration is there inaudible.

31st, Dyspnœa increased. Over the whole anterior part of the chest strong *bruit de soufflet* is heard, accom-

panying the pulsations of the heart, and obscuring the sound of respiration in its vicinity. The action of the heart is very irregular, and impulse stronger than natural.

6th, Much dyspnœa, relieved considerably by the erect posture. Feels exhausted. Œdema increased. Pulse 104, firm, less full.

7th, Died yesterday afternoon.

8th, *Examination.*—There were about six pounds of clear serum in the right side of the thorax. Slight emphysema of the right lung at its anterior edges; but it was otherwise natural. Very little serum in the left side of chest. Left lung natural. Eight ounces of clear serum in the pericardium.

Heart enlarged. Parietes of left ventricle much thickened, being about an inch in breadth at the thickest part, and between five and six times the breadth of the walls of the right ventricle; the cavity of the left ventricle was likewise much enlarged. The edge of the mitral valve was slightly puckered, and thickened, particularly at one place, where there was a cartilaginous patch, about one-eighth of an inch thick, and about half an inch in breadth. The cartilaginous body seemed to be situated between the two folds of membrane of which the valve is composed.

The aortic opening was contracted by the thickening and puckering of its parts. The semilunar valves were of a fibro-cartilaginous texture, and thickened, especially about their loose edges, where this amounted to nearly one-eighth of an inch. These valves, moreover, were corrugated, and as it were drawn towards each other, thus narrowing the aortic exit. At the base of one of them, on its aortic surface, there was an earthy deposit; and attached to the ventricular surface of each there were several fibrinous projections or vegetations. One of these was about half an inch in length; another projected from the base of one of the valves, having also an attachment to the inner surface of the ventricle immediately adjoining, but it was not so long as the former.

The aorta, throughout its whole extent, was much diseased, as well as the arterial system generally. Its inner surface was quite irregular with numerous but slight elevations, some of which were cartilaginous in structure; others were of a yellowish colour, and cheesy consistency; while a few had earthy deposits in their centres. These appearances were found to exist chiefly between the inner and middle coats; many, however, involved both. The earthy deposits projected through the inner membrane. The coats of the vessels affected were much thickened in consequence.

The arch of the aorta was enlarged to fully twice its

usual size; and immediately above the semilunar valves there was an aneurismal sac, which might have held a small walnut; it was about one inch deep. About half an inch above this, there was another sac, which easily admitted three fingers; it was about three inches deep, and of a conical shape. There was a considerable quantity of coagulated blood in this sac. Its parietes were partly lined by the serous membrane of the aorta, partly composed of condensed cellular membrane. Both of these sacs arose from the right side of the ascending aorta and arch, and projected towards the right side of the chest. The largest adhered by its conical extremity to the anterior part of the right lung.

The walls of the right ventricle were rather thinner than usual, and the cavity itself somewhat dilated. Its valves were healthy. The coronary arteries were slightly diseased.

Remarks.—The *bruit de soufflet*, in this case, was probably consequent upon the contraction of the aortic opening of the left ventricle, caused by the obstructions mentioned. The impulse was strong, and there was hypertrophy of the left ventricle. The sound was diffused, and the ventricle was dilated.

The aneurismal pouches might perhaps have been discovered by a very careful examination on Dr HOPE'S

plan. The largest, had the patient lived, would in all probability have burst into the right lung or cavity of the pleura. The dull sound on percussion, and absence of the respiratory murmur, in the lower part of the right side of chest, are to be accounted for by the presence of the serum in the right pleura.

CASE XXXIV.

DILATATION OF LEFT VENTRICLE, WITH DISEASE OF THE SEMILUNAR VALVES.

H. C., a woman, æt. 42, April 25. 1827.—Has dyspnoea on the slightest exertion, but particularly on ascending a height, when it is aggravated almost to suffocation, accompanied by palpitations, but without pain. She can lie in any position. Legs œdematous. Face slightly livid. Sleep disturbed by starting. Pulse 104, very strong and hard, with a double beat about once in twenty. Strong pulsation is observed at the upper end of the sternum, between the insertions of the sterno-mastoid muscles, and extending a little towards the right shoulder, communicating a thrilling sensation. There is pulsation of the right jugular vein. The apex of the heart is felt beating below the left mamma, and the sound of its ac-

tion may be heard over the whole anterior part of the thorax and in each axilla, particularly the left; but very faintly on the back. *Bruit de râpe* is very distinct along the two upper thirds of the sternum, and faintly heard along the spine.

Her symptoms became aggravated, and she died.

Examination.—The pericardium contained eight ounces of slightly turbid serum. There was no effusion into the chest. There was slight hypertrophy of the right ventricle, and dilatation of the left. There was a considerable calcareous deposition in the semilunar valves of the aorta. The aorta was not dilated, but its coats were much diseased, in the same way as has already been described in the previous case.

Remarks.—The diffused sound of the action of the heart may be accounted for by the dilatation of the left ventricle,—the *bruit de râpe*, by the calcareous deposition at the mouth of the aorta narrowing the passage for the exit of the blood.

There was some thickening of the walls of the right ventricle, at the same time the impulse of the heart was not remarked as unusually powerful; but the thickening was not to a great extent.

CASE XXXV.

DISEASE OF THE MITRAL VALVE.

M. J., a woman, æt. 34, November 17. 1829.—Has been incoherent for several days, and has paralysis of the lower extremities, right arm, and of the right side of the face. Pulse 120, very feeble in the left wrist; imperceptible in the right, and only felt high in the axilla, where the pulsation abruptly becomes strong. Is reported by her acquaintances to have been in pretty good health about a fortnight ago, though occasionally complaining before that. Took to her bed about that time, and eight days afterwards her memory and speech became impaired.

19th, Answers questions incoherently, but puts out the tongue when desired. Pulse 80. Impulse of the heart very indistinct, but there is strong *bruit de soufflet* accompanying the beat of that organ, which pulsates in the usual place.

20th, Died this morning.

Examination.—There was some ramollissement of the left side of the brain, and its surface was drier than usual.

The heart was of natural size, and the size of its cavities and thickness of their walls were also natural.

There was slight disease of the inner membrane of the aorta here and there, particularly at the giving off of the great vessels and vertebral arteries; but, with these exceptions, the membrane was quite smooth and healthy. The sigmoid valves of the aorta were more opaque than usual, and there was slight cartilaginous thickening at the bases of two of them; they appeared, however, to be quite fit for the performance of their office.

The larger segment of the mitral valve was quite natural; the other portion had several firm fibrinous concretions projecting from its auricular surface, and besides there was a foramen through it, apparently ulcerated, capable of admitting a small goose quill (See Plate XIII. Fig. 2. a.)

The right humeral artery, immediately below the point where the pulsation was perceptible, contained a firm plug of fibrine, adhering to its inner membrane. The latter was thickened, and very easily separated from the middle coat. The vessel below this was diminished in caliber; while above it was of the natural size.

Remarks.—The *bruit de soufflet*, the only remarkable circumstance connected with the action of the heart in this case, may have been owing to the diseased state of

the smaller segment of the mitral valve acting as a foreign body; or the blood, by this may have rushed back into the auricle, partly causing the peculiar sound; or the quantity of blood in the heart may have been unusually great.

CASE XXXVI.

HYPERTROPHY OF LEFT VENTRICLE, AND DISEASE OF THE MITRAL VALVE.

M. H., a woman, æt 40, February 9. 1829.—Respiration hurried, 36 in a minute. Pulse 120, feeble. Has cough in fits, accompanied with mucous expectoration. No pain in the chest. Slight lividity of countenance, with expression of anxiety. Great dyspnœa on any unusual exertion, or when in the recumbent posture, accompanied with palpitation of the heart.

10th, Action of the heart strong, with slight *bruit de soufflet*. Respiration hurried. Slight lividity of lips.

13th, Breathing more oppressed, with occasional paroxysms of dyspnœa. Impulse of heart not much increased; sound of its action pretty loud, with *bruit de soufflet*.

21st, Action of the heart somewhat stronger than na-

tural, and apex felt below 6th rib. *Bruit de soufflet* continues. Cough less.

April 1st, Dyspnœa urgent at night, and in the afternoon. *Bruit de soufflet* still heard.

5th, Breathing easier; little cough. Pulse 100, soft. Some palpitation, but less than formerly. Respirations 22.

7th, Pulse 112, weak and small. Lividity of lips: Much debility. Breathing easier.

8th, Died early this morning.

Examination.—The larger segment of the mitral valve was much thickened and corrugated. It was about one-eighth of an inch in thickness at some places, and approached the nature of cartilage. The semilunar valves of the aorta were slightly opaque here and there. There was a little thickening of the walls of the left ventricle. The heart was otherwise natural.

Remarks.—In this case the *bruit de soufflet* was probably caused by the disease of the mitral valve, perhaps in consequence of the rushing of the blood back into the auricle, during the contraction of the ventricles, but probably in part owing to the strong action of the organ consequent upon the hypertrophy forcing the blood with great power into the aorta.

CASE XXXVII.

DILATATION OF THE LEFT VENTRICLE, AND DISEASE OF
THE MITRAL VALVE.

M. S., a woman, æt. 40, October 27. 1829.—Sleep disturbed. Breathing quick; cannot assume the horizontal posture from the dyspnœa, which is always produced by this. Cough, with frothy expectoration tinged with blood. Is subject to dyspnœa and palpitation on any unusual exertion. Occasional vertigo. Expression anxious, complexion sallow. Slight œdema of ankles and feet. Urine scanty. Chest sounds well on percussion, except in the region of the heart, and at the lower parts of chest posteriorly. Sound of respiration heard puerile at the upper parts of chest, feebler at the lower parts, posteriorly, and almost every where with catarrhal rales. Pulse 120, rather sharp, and very slightly irregular. Apex of heart felt between 6th and 7th ribs; impulse pretty strong, and accompanied with distinct *bruit de soufflet*. Action of the heart perceived more diffused than natural, and nearly all over the chest anteriorly and posteriorly. There is strong pulsation of the right subclavian artery, and of the right subclavian vein. The veins on the left side of the neck do not pulsate.

Has been more or less subject to these complaints for about sixteen months, but they have become much aggravated within the last three weeks.

30th, Mucous, sibilous, and sonorous rales heard yesterday, anteriorly, and especially under the left clavicle, now gone; and sound of respiration there pretty good; sound on percussion, and of respiration, posteriorly, natural. Pulse 100, softer. Heart's action perceived generally over the chest, anteriorly, particularly towards the top of the sternum, and as low as the 6th and 7th ribs.

1st November, Expectoration continues as before, very frothy, and of a florid red colour, but not very tenacious. Increased impetus of the heart's action felt distinctly below the 6th rib. *Bruit de soufflet* still heard.

2d, Dyspnœa, amounting sometimes to orthopnœa. Pulse 100, rather sharp.

3d, Cough and expectoration as before. Œdema of legs increased. Urine scanty. Pulse 108, rather sharp, easily compressed. Impulse of heart increased.

6th, Continued much as before; and died this morning.

Examination.—There were about two ounces of clear serum in the pericardium, and a few ounces in each side of the chest.

Heart much enlarged; all its cavities contained dark

coagulated blood. Great dilatation of the left ventricle; walls five-eighths of an inch thick; while those of the right were less than half of this. The right ventricle was not much dilated.

The mitral valve was considerably thickened towards its edges, being fully more than one-eighth of an inch in thickness there. The smaller segment of the valve had several fibrinous masses projecting from its auricular surface, one of which contained some earthy matter. There were several fibrinous concretions attached to the larger segment, on both surfaces, and on several of the chordæ tendineæ of the one side there were concretions of a similar nature, in small round dots, something like strings of very small beads; there was one very fine tendinous filament, which stretched across from one part of the ventricle to another, and particularly presented this appearance. By these concretions the left auriculo-ventricular opening was decidedly contracted in its diameter.

The sigmoid valves were considerably thickened, and here and there had small fibrinous projections attached to them.

Heart appeared otherwise natural.

The aorta was generally diseased, particularly the arch, which was, besides, somewhat dilated. The inner surface of the aorta was rough with numerous yellowish-white spots, and here and there calcareous depositions.

The larger arteries examined were diseased in a similar manner. There was very slight disease of the pulmonary artery; its inner surface, however, presented several small yellowish-white spots, like those seen in the aorta.

Remarks.—The stethoscope indicated a large heart. Its action was more diffused than natural, and there was dilatation of the cavities. The diffused action may have been in part, however, owing to the serum in the pericardium. The impulse was always strong, but became much increased a few days before death. The walls of the left ventricle, however, were not much increased in thickness, but the cavity was dilated. The left ventricle, then, was in a state of active aneurism, that is, the walls did not become thinned as the cavity became dilated, but preserved much their usual thickness, by an addition of substance as the dilatation proceeded.

The *bruit de soufflet* was probably owing to the state of the left auriculo-ventricular opening, in consequence of which the blood would not be prevented from rushing back into the auricle during the contraction of the ventricle; or the diseased mitral valve might have acted as a foreign body projecting from the floor of the ventricle, and thus been a cause of the sound. The disease of the sigmoid valves, which, however, was slight, might perhaps contribute to cause the sound also.

CASE XXXVIII.

DILATATION OF THE HEART, AND DISEASE OF THE
MITRAL VALVE.

S. A., a woman, æt. 21, May 6. 1829.—Is subject to palpitation and dyspnœa. Has cough, with mucous expectoration, and occasional pain of chest. Abdomen somewhat swollen, and painful on pressure. Legs and feet œdematous. Pulse 120, small. Bowels open. Urine scanty.

States that she has been subject to dyspnœa and palpitation for about six months; but that the œdema of limbs took place only about a month ago.

8th, Breathing easier; little cough. Œdema nearly gone. Urine pretty copious. Heart felt beating betwixt the 6th and 7th ribs. Impulse increased, with strong *bruit de soufflet* heard over the greater part of the chest anteriorly. Pulse 104, rather small.

12th, Urine two pounds, clear. Breathing easier, and action of heart less strong.

15th, Has complained since last night of pain under the left vertebral ribs; increased on coughing. Pulse 100, soft. Tongue white. Breathing easy; and full inspiration does not cause pain.

17th, Pain of side nearly gone. Action of heart less strong. *Bruit de soufflet* still heard. Heart felt beating betwixt the 5th and 6th ribs.

28th, Action of heart little increased; otherwise no complaint.

She continued in tolerable health for some time after this, but her complaints again became aggravated; and the following is the continuation of her case.

24th June 1830, Palpitations of heart easily induced, and accompanied with dyspnoea, increased by lying on the right side, but not accompanied with any cough or pain in the chest, unless when the palpitations are violent. Her breathing is very quick, but not laborious in the erect posture. The vesicular respiration in the upper part of the left side of chest is puerile; in the lower part indistinct, being masked by the sound of the action of the heart. On the right side respiration seems natural.

The impulse of the heart is more diffused than natural, and felt below the 6th rib. The sound of the action of the heart is heard over most of the anterior part of the chest, but particularly at the lower part of the sternum, and opposite the 5th and 6th ribs of the left side, where, especially in the latter place, a *bruit de soufflet* is heard; both sounds of the heart having that character, the first stronger than the second.

There is general œdema of the lower extremities, of a month's standing. Urine much diminished in quantity. Bowels regular. Catamenia suppressed for two years. Skin of a sallow complexion.

29th July, Œdema increased to a very great extent. Action of the heart is heard over the whole anterior part of the chest, with a sound somewhat between the *bruit de soufflet* and *bruit de râpe*, which is most distinctly heard about the 6th rib.

The impulse of the heart is very strong, and diffused. There is pulsation of the right jugular vein. Pulse small, and weak. Great œdema of arms, especially of the right one. Vesicular respiration indistinct along the lower part of the chest; in the upper part the respiration is natural. Urine scanty.

23d, Yesterday, dyspœa and coldness of extremities gradually increased. Pulse became weak and fluttering, and she expired about 12 P. M.

Examination.—There was a small quantity of serum in both sides of the chest. The lungs contained a considerable quantity of serum in their posterior portions, but were otherwise healthy.

The heart was much enlarged, and the pericardium adhered universally to it.

All the cavities of the heart were much dilated, and

their parietes were perhaps rather more than of the usual thickness. The aortie valves were healthy.

The left auriculo-ventricular opening was much contracted, partly by the corrugation of the mitral valve, partly by the presenee of a considerable irregular calcareous deposition upon it, and nearly surrounding the opening. The auriculo-ventricular opening, in this state, admitted only a little more than one finger.

The other valves of the heart were healthy.

There was a little serous effusion into the abdomen; the viscera, however, seemed healthy.

Remarks.—The diffused and increased impulse were caused by the action of an enlarged heart; the walls of the cavities of which, notwithstanding their great dilatation, had fully preserved their usual thickness.

The *bruit de soufflet*, heard in this case about a year before her death, and which latterly assumed somewhat the character of the *bruit de râpe*, probably from aggravation of the disease, may be accounted for by the disease of the mitral valve, which in this case could scarcely have performed its office at all. The first sound may have been caused by the regurgitation of the blood into the auricle through the narrow auriculo-ventricular opening, during the contraction of the ventricle.—the second, by the rushing of the blood into the ventricle, caused by

its forcible and elastic dilatation, through the same contracted opening.

CASE XXXIX.

DILATATION OF THE VENTRICLES, WITH DISEASE OF THE
MUSCULAR PILLARS OF THE MITRAL VALVE.

P. R., a man, æt. 37, October 10. 1829.—Has been subject to cough, dyspnœa, and palpitation, for about twenty years. Has œdema of limbs, and swelling of abdomen, which were noticed several weeks ago; fluctuation is evident in the latter. Cannot lie on the left side. Pulse, 114, regular.

13th, Urine scanty. Breathing easy.

15th, Action of heart diffused; impulse not strong, but accompanied with distinct *bruit de soufflet*, which is slightly heard on the right back, and progressively more distinctly towards the region of the heart. Respiration puerile at the upper parts of the chest.

21st, Breathing more difficult. Urine very scanty.

24th, Sonorous rale distinctly heard all over the chest anteriorly; not examined posteriorly. Action of the heart as before. Sonorous rale heard in the region of the heart, synchronous with the impulse of that organ, which is not strong.

29th, Dyspnœa considerable. Œdema and swelling of abdomen increased; cannot lie in bed, but sits up.

1st November, Emaciation of face evident; debility increasing.

2d, Pulse 64. Dropsy much increased; dyspnœa and cough very troublesome. Urine scanty.

11th, Action of the heart diffused; *bruit de soufflet* distinct.

19th, Much œdema of upper and lower extremities; *bruit de soufflet* distinct.

22d, Symptoms much as before; some delirium.

23d, Died this morning.

25th, *Examination*.—Heart generally enlarged. Ventricular cavities enlarged. Walls of usual thickness. Right ventricle otherwise natural.

The muscular pillars of the mitral valve, on one side of the left ventricle, were perhaps larger than natural, and of the usual fleshy character. Those of the opposite side were much less than usual, and of a white fibro-cartilaginous structure, presenting, along with that half of the inner surface of the ventricle, a sort of fibro-cartilaginous aspect, and contrasting remarkably with the muscular redness of the other half of the ventricle. The muscular structure seemed, in the pillars described, to have entirely disappeared, and become replaced by the fibro-cartilaginous structure mentioned (See Plate XIV.

Fig. I. *a.*) The chordæ tendineæ of the affected side, instead of being tense, as is usual, and was the case on the sound side, were quite flaccid; and the larger segment of the mitral valve, at the side where these chordæ tendineæ were attached to it, hung down quite flaccid, larger than usual, and as if it had been stretched.

One of the diseased pillars, and a portion of the floor of the ventricle, were covered with a deposition of a fibrinous-looking matter, in the form of small granules, something like grains of sand, closely arranged side by side (*b.*)

The sigmoid valves of the aorta were somewhat thickened, and the inner surface of the aorta was slightly diseased in the usual way.

Remarks.—The diffused action of the heart, in this case, agrees with its large size, and the dilatation of its cavities. The *bruit de soufflet* here, as in the next case, occurs with the presence of disease of the pillars of the mitral valve. They could not, in such a state, have contracted; hence the side of the valve connected with these pillars, by means of the chordæ tendineæ, may have permitted a reflux of blood into the auricle during the contraction of the ventricle, or the diseased columnæ may have acted as foreign bodies in the floor of the ventricle.

The sonorous rale, heard synchronously with the im-

Fig. 2.

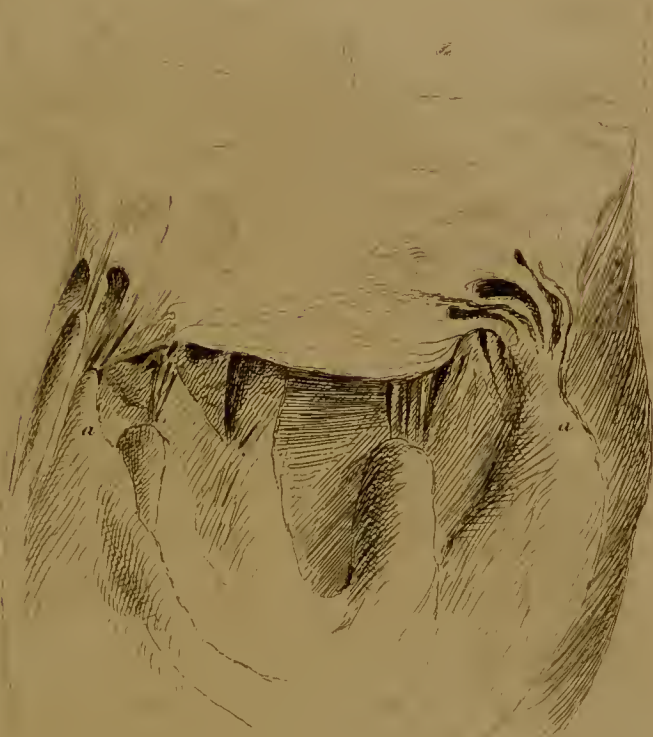
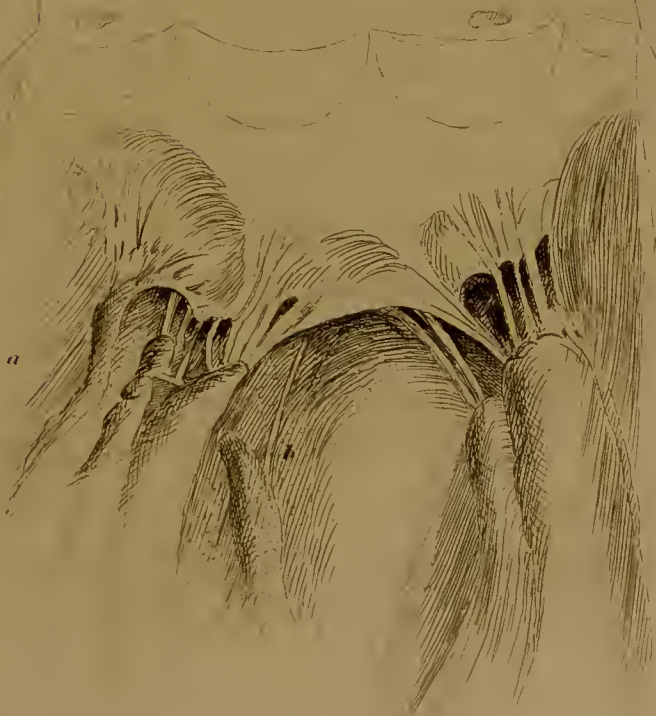


Fig. 1.





pulse of the heart, must have been owing to an intervening portion of lung between the apex of the heart and parietes of the chest, being compressed during the action of that organ.

CASE XL.

DILATATION OF THE LEFT VENTRICLE, AND DISEASE OF THE PILLARS OF THE MITRAL VALVE.

B. M., a woman, æt. 26, September 30. 1829.—Has within the last two years had several attacks of articular rheumatism. A few days ago, after exposure to cold and wet, was attacked, with dyspnœa and cough, without expectoration. Œdema of legs, and swelling of abdomen, soon followed. These symptoms have since daily increased, and at present the œdema of the limbs is great, and the dyspnœa severe. Pulse 90, firm. Action of heart strong, with distinct *bruit de soufflet*.

2d October, Breathing relieved. Pulse 110, very irregular. Pulsations of heart rather diffused, and felt by the hand very strongly. There is some tenderness in the epigastrium, and occasional pain in the region of the heart.

3d, Pulse 80, regular. Impulse of heart much less strong, but still with *bruit de soufflet*.

15th, Impulse of heart not strong. Distinct *bruit de soufflet* accompanying the impulse of heart, evident nearly all over the chest; weakest on the back of the right side. Vesicular puerile respiration heard at the upper parts of chest, on both sides.

11th November, Abdomen distended, with distinct fluctuation. Great œdema of legs.

25th, Pulse rather frequent, feeble, irregularly intermittent. *Bruit de soufflet* very strong.

2d December, Dropsical swellings not abated. Pulse firm, natural in frequency.

11th, Drowsiness; oppressed look; impaired memory.

15th, Continued very drowsy; became comatose, with some twitching of the arms; and she died this morning. Her urine had always been scanty.

16th, *Examination*.—A large quantity of serum was found in the abdomen; some in both sides of chest, and a little in the pericardium.

The heart was larger than natural. There was some dilatation of the left ventricle; its parietes were much about the natural thickness. The edge of the larger segment of the mitral valve was much thickened, and corrugated. The smaller half was also slightly thickened. The chordæ tendineæ attached to the larger segment, instead of being tense, as in the natural state, when the

ventricle is opened, were loose, especially those of one side, and the muscular pillars to which they were attached had become shrunk in size, and in part entirely lost their muscular character, being of a white colour, and fibro-cartilaginous texture (See Plate XIV. Fig. 2. *a a*.) The upper part of one them, for about the extent of half an inch, was entirely converted into this substance throughout.

The muscular pillars, from which the other segment of the mitral valve was supplied with chordæ tendinæ, were of their natural structure. Immediately within this valve, the surface of the auricle was rough to a small extent, with a fibrinous deposition attached to it.

On the outer surface of the heart there was a patch of the serous covering of the organ, much thickened, and of a white colour.

There was incipient disease of the aorta. The kidneys and the liver were diseased.

Remarks.—The diffused sound of the heart's action accords with its increase in size, which was principally by dilatation of its cavities, and of the left ventricle particularly. The *bruit de soufflet* we would attribute to the disease of the mitral valve and its muscular pillars.

In this case, the pillars of the larger segment of the valve could not have contracted properly: hence there

may have been regurgitation of blood into the auricle ; and indeed this may perhaps be one great source of the distressing dyspnœa in such cases of disease of the heart. But it appears possible that the sound may be produced, in cases like the present, by the state of the pillars of the valves, acting as foreign bodies projecting from the walls of the ventricle ; for, from their diseased state, it must have been impossible for them to have contracted, except to a very slight extent.

CASE XLI.

DILATATION OF THE CAVITIES OF THE HEART.

J. A., a boy, æt. 11, September 10. 1829.—Has severe cough, with scanty mucous expectoration, exciting severe pain in the chest. Abdomen swollen ; generally tender on pressure, especially in the epigastrium, with an indistinct sense of fluctuation at the lower part. Slight œdema of feet. Lies easiest on the left side. Respirations 44. Pulse 112, small and sharp, but regular. Impulse of the heart not strong, but sound of contraction of the ventricles much louder than natural, and jarring, with distinct *bruit de râpe*, and heard over a much larger surface than natural. The purring fremitus is felt by the hand

applied in the præcordial region. Tongue white, moist. Much thirst. Bowels open. Complaints reported to have commenced about four days ago, with œdema of legs, followed by swelling of the abdomen, and œdema of hands and face. Much about this time the pain of chest, and cough, supervened.

Had a similar attack about six months ago, which continued about five weeks.

12th, Urine scanty, high coloured, and deposits a whitish sediment. Breathing still frequent. Pulsation in both external jugular veins. Slight lividity of face. Cough and expectoration less. Still complains of epigastric tenderness. Pulse 108, regular, and of good strength. Lies constantly on the left side. Œdema nearly gone.

13th, Sound of heart's action less strong. *Bruit de râpe* less marked, and the sound is more like the *bruit de soufflet*.

29th, Urine very scanty. Nausea. Increased dyspnoea. Much languor.

7th October, Dyspnoea increased. Action of the heart as before.

10th, Died early this morning.

11th, *Examination*.—The pericardium was much thickened, and adhered generally to the surface of the heart, except over the left ventricle, for the extent of two or

three inches, forming a cavity filled with sero-purulent fluid, having flakes of lymph floating about in it; and there was a tolerably thick deposition of lymph on the surface of the heart at that point.

The heart was very much enlarged; there was great dilatation of all the cavities, more especially of the left side of the organ, and least of the right auricle; but these cavities had preserved completely their usual thickness. All the valves were quite sound, but the mitral valve appeared much too small to have closed the auriculo-ventricular opening, which was larger than usual.

Remarks.—The diffused action of the heart indicated enlargement of its cavities. The impulse did not denote great thickening. It is difficult in this case to explain the cause of the change of the intensity of the sound, which at first was the *bruit de râpe*, but latterly the *bruit de soufflet*, unless it be admitted that the motion of the blood upon the solid parts of the heart is the cause of such; then it is easy to understand how bleeding or other circumstances might tend to produce the change in question, as has been formerly mentioned.

The small size of the mitral valve, did it really not suffice to close the proper opening, may have allowed a reflux of blood into the auricle, and thus been a cause of the sound mentioned.

CASE XLII.

ANEURISM.

W. S., a man, æt. 48, August 29. 1829.—At the bend of the right arm, on the ulnar side of the tendon of the biceps muscle, there is an oblong pulsating tumour, about the size of a hen's egg. It has never been attended with much pain nor inconvenience, and has not, according to the patient's account, sensibly increased in size for the last six months. He reports that it followed the operation of bleeding performed by a non-medical person, and rapidly made its appearance.

By pressure with the fingers, the tumour can be very much diminished in size; but it quickly rises when the pressure is withdrawn.

On applying the ear, or better, the stethoscope over the tumour, besides perceiving a slight impulse, we hear a very distinct sound, remarkably like the *bruit de soufflet*, but at each beat of the pulse the sound is much increased, and slightly altered in character; it is then a kind of whirring *bruit de râpe*, the bellows-sound filling up the interval between the whirring or harsher sounds. By applying the instrument either above or below the tumour, for a consi-

derable way, these sounds can be distinctly heard, though of course always most intensely near the tumour.

Remarks.—This, from the various symptoms mentioned, appears to have been either a case of aneurismal varix, or varicose aneurism, caused by a wound of the humeral artery below the vein, and of the vein at the same time.

The sound which we have described as the whirring *bruit de râpe*, may be attributed to the forcible rushing of the arterial blood from the wound in the artery, into the aneurismal sac, consequent upon the contraction of the left ventricle; while the *bruit de soufflet*, heard in the intervals, may be supposed to have been owing to the more gentle rushing of the arterial blood into the tumour, during the dilatation of the ventricles.

Surgical authors have characterized this species of aneurism by its tremulous or jarring motion, and hissing noise, heard accompanying each beat of the artery; and it is to this hissing, with the jarring motion, that we have applied the term whirring *bruit de râpe*, because such is more according to the nomenclature in auscultation.

By mediate auscultation, or by the application of the ear close to the tumour, we learn, that, besides the sound described by surgeons as the hissing noise, there is a more gentle sound, to which we have applied the term *bruit de soufflet*.

There can be no doubt that these sounds are produced by the motion of the blood, and this is an additional testimony in favour of such, being the cause of similar sounds, in other cases*.

CASE XLIII.

SUBINTEGUMENTARY EMPHYSEMA FROM A FRACTURED RIB.

M., a woman, æt. 48, March 9. 1830.—On 4th March she fell, and struck her left side with great violence against the edge of a tub. She immediately afterwards felt acute pain in the site of the injury, attended with troublesome cough, and much aggravated by it, and likewise on taking a full inspiration.

Symptoms continuing severe, she was bled from the arm three days ago, with considerable temporary relief; and, although they have returned to a considerable de-

* In the Edinburgh Medical and Surgical Journal, No. 103, we have given an account of a case of aneurism of the abdominal aorta. Several months before the patient's death, very slight *bruit de soufflet* was heard in the tumour, which, however, completely disappeared long before that took place, with a decrease of impulse. This was easily accounted for by the deposition of fibrine in the tumour, which had taken place to a great extent before death.

gree, they are by no means so severe now, as they were previously.

The 10th rib of the left side is fractured a little posterior to its junction with the cartilage.

There is pretty extensive discoloration of the skin over the part, and the skin over almost all that part of the chest is puffy and emphysematous. Upon its being pressed with the fingers, a crepitating sensation is distinctly communicated.

By auscultation, this crepitating sound is much more evident, and resembles very nearly the *râle crepitant* of pneumonia. It can be heard over every part of the left side of chest, between the spinous processes of the vertebræ and sternum, up to the shoulder, and down to the lower part of the chest. Percussion over this side is not quite dead, but without that hollow resonance peculiar to a healthy chest; it is, as it were, somewhat muffled. In consequence of the crepitation, the respiratory murmur in that side is not audible. The slightest pressure with the end of the stethoscope, or with the fingers near it, or a deep inspiration, render the crepitation quite evident. The respiratory murmur in the right lung is by no means loud, though distinct.

Cough is not very frequent or severe, and pain of side is only felt when she coughs or inspires deeply. Respiration is easy, and the mobility of left side of chest does

not seem impaired. She can lie with ease only on the back or the left side. Has never expectorated blood.

The emphysema did not increase; but she had severe pain in the chest, for which very active treatment was required. She eventually, however, completely recovered.

Remarks.—The crepitating sound heard over the left side of the chest, in this case, was owing to the presence of the effused air, caused by the fractured rib, which, of course, must have punctured both the lung and the parietes of the chest, the skin excepted. The immediate cause of the sound can only be attributed to the bursting of minute air-bells, formed by the intermixture of the air and subintegumentary serous fluid.

CASE XLIV.

PNEUMO-ABDOMEN, WITH PERFORATION AND DISTENSION
OF THE ILEUM,

D. S., a man, æt. 20, September 28, 1830.—Complains of pain in the right hypochondrium, increased on pressure and coughing, and occasionally extending upwards to the shoulder. There is great distension of the abdomen, and pain in the lumbar region, extending forwards

and downwards. When lying in the horizontal posture, the abdomen in its lateral parts sounds dull on percussion, and fluctuation is also felt there. In the same position the upper and anterior parts of the abdomen sound loudly tympanitic; and, at the part where the dull sound passes into the tympanitic, percussing causes a peculiar fluctuating sound, very exactly imitated by percussing a stomach or bladder, containing a little liquid and air, at the line where these fluids touch each other.

He is constantly troubled with severe colicky pains, and with a feeling of a great distension of the abdomen. Borborygmi extremely loud, but these subside without any discharge of flatus. Pulse 90, soft. Respiration rather frequent, not difficult. Stools clay-coloured, and he seldom passes any flatus with them. For some time bowels have been very constipated. Scrotum and lower extremities œdematous.

States, that in April last he began to complain of pain in the right hypochondrium, which was often relieved, but never entirely removed, by medicine. The swelling of abdomen commenced about two months ago. Extremities became œdematous a few weeks ago.

1st October, Less tension of the abdomen; feels easier.

3d, More uneasy. Bowels rather loose, and tension of the abdomen increased. Pulse small.

5th, Complained much during the night of pain in the

right shoulder and back, and was much troubled with borborygmi, but is now considerably easier. Bowels open.

6th, Complained much of pain during the night, but slept well towards morning; great tympanitic distension of abdomen. Percussion over the latter, when he is sitting up, quite tympanitic laterally, and even in the hypogastric region; but, when he lies on his back, and inclines a little to one or other side, the lower side is dull on percussion, to a slight extent upwards, and at the point where the sound becomes tympanitic, the peculiar fluctuating sound mentioned is heard on percussion. At one period of this examination very loud borborygmi were heard by the naked ear, but still more distinctly by the application of the stethoscope to the abdomen. The sound produced by the motions of the fluids contained in the intestines were exceedingly loud, and far surpassed the usual sounds produced in the same way, and heard by the same means.

The metallic resonance, which formed one of the sounds, was heard all over the abdomen, louder at one place than another, but constantly varying in position. An opportunity was taken, when the borborygmi had ceased, to try if the metallic resonance could be produced by tapping on the abdomen, and this was found to be the case generally over it; and it was distinctly heard, on the

application of the stethoscope, in the neighbourhood of the part percussed.

7th, Distension, pain, and borborygmi very much increased.

8th, Slept tolerably during the night; towards morning, however, the feeling of distension became aggravated; respiration became more laborious; pulse more feeble, and he expired about 2 P. M.

Examination.—October 9. 4 P. M.—Abdomen perhaps rather more tense and distended than during life, and is quite tympanitic on percussion.

On making a puncture into the peritoneal cavity, a large quantity of air made its escape with a rushing noise, and the abdomen, generally, diminished much in size, and became flaccid.

On opening the abdomen, about three or four convolutions of enormously distended intestine were found to occupy the upper part of the cavity, and almost entirely conceal the rest of the contained parts.

On tracing the intestines from the lower end of the ileum upwards, it was observed that, about two feet from the ileo-cæcal valve, there was an adhesion of the ileum to the brim of the pelvis. From this point the intestine upwards, for about five or six feet, was enormously distended, while below it was of the natural caliber.

The distended portion of intestine admitted the hand easily, and without the slightest increase of distension; while that below the adherent portion, would, at the most, have admitted three fingers only.

At the part where the intestine adhered to the edge of the pelvis, there were two small perforations through its coats into the cavity of the peritoneum; and there was also another, about two feet above this. These openings might easily have admitted a small crow-quill.

The coats of the intestines, where these were distended, were somewhat thickened.

At the adherent point the ileum was found diminished in caliber, but it easily admitted the fore finger. Projecting from its inner surface at this point, there was a dark purplish coloured soft fungoid looking tumor, and around this, some ulceration of the intestine. The diseased portion mentioned was intimately connected with some diseased glands, which, indeed, seemed to be the chief cause of the narrowing of the intestine.

Around the opening further up the intestine, there was, on its inner surface, some ulceration, and also a small fungoid projection of a purple colour.

The distended portion of ileum contained a considerable quantity of thin clay-coloured fæculent matter, and a very large quantity of air.

The mesenteric glands, generally, were in a state of

disease, being enlarged, and changed into cream-coloured soft masses.

There was upwards of a pound of brownish-yellow purulent fluid in the cavity of the peritoneum; and on the peritoneal surface of the intestines here and there an effusion of recent lymph.

The liver was of a pale colour, and adhered by firm adhesions to the abdominal parietes.

The other abdominal organs seemed healthy.

There was slight emphysema of both lungs, and a little serum in both pleuræ, and in the pericardium.

Remarks.—The dull sound on percussion, at the side of the abdomen,—altered by change of position, and accompanied with a feeling of fluctuation,—at the same time that it indicated the presence of fluid in the abdomen, also proved this to be small in quantity; while the peculiar fluctuating sound, mentioned in the history of the case, as well as the tympanitic sound on percussion, seemed to indicate the presence of air, likewise, in the cavity of the peritoneum; for it is otherwise difficult, if not impossible, to account for the peculiar sound mentioned, which could not owe its existence at all to the air in the intestines, it only being heard at the line where the dull sound on percussion passed into the tympanitic, and, as already mentioned, exactly resembled the sound

produced by percussion on a stomach or bladder containing liquid and air, at the point where these fluids touch each other.

The tympanitic sound, on percussion, it is true, was no decided proof that there was air in the cavity of the peritoneum, for this would have been the case independently, from the great quantity of air in the intestines.

The metallic resonance heard, accompanying the motion of the fluids in the intestines, as well as the production of this phenomenon by percussion on the abdomen, were distinct proofs of the existence of a large quantity of air in the abdomen; and the former proved its existence in the intestines; but, in the latter case, the metallic resonance may have been owing to the existence of air either in the intestines or cavity of the peritoneum, or in both.

To ascertain how these sounds were produced, we took an opportunity of percussing a stomach distended with air, and found that a distinct metallic resonance was thus produced. We also tried the same experiment with a portion of the great intestine much distended with air, and found that the same took place; and after the introduction of a little liquid, the intestine in this experiment also being distended with air, a sound very like that heard in the above case was perceived when

the intestine was agitated. We have given this case to shew the possibility of the use of auscultation being sometimes extended. No general conclusion of course can be drawn as to the use of auscultation, in such instances, until after considerable experience. We are not aware, however, that similar observations have been made in cases like the present.

FINIS.





